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Torpedoing a Submarine from an Aeroplane

BECAUSE an airman flying above the water can sight an underwater craft and detect its approximate depth with the naked eye, inventors have devised a number of bomb-dropping contrivances in an endeavor to make the most of this strategic advantage and place the submarine at the mercy of the aeroplane. One of the most recent of these devices is an aerial torpedo or bomb containing high explosive which when dropped from the aeroplane makes a rapid and straight descent beneath the water and explodes at the proper depth and proximity to wreck a submarine.

The bomb consists of a shell filled with high explosive and into its closed end is fixed a detonator which consists of a tube containing a layer of metallic sodium, a layer of gun cotton and a layer of ordinary fulminate. Attached to the shell is a parachute, which is nothing but a dished circular plate. This acts as a guide in the descent of the bomb from the aeroplane to the water and also regulates the speed of the bomb once it is under water, allowing it to sink slowly.

The cover of the bomb as well as the cap of the detonator-tube are perforated. When the bomb has sunk to a certain distance, water flowing in through these perforations ignites the sodium (a property of sodium), which fires the gun cotton, which discharges the fulminate, which sets off the bomb. These different stages leading up to the actual explosion occur nearly simultaneously, but should they fail—that is, should the unforeseen happen and the sodium not ignite, an electrical igniting mechanism is provided which will discharge the fulminate.

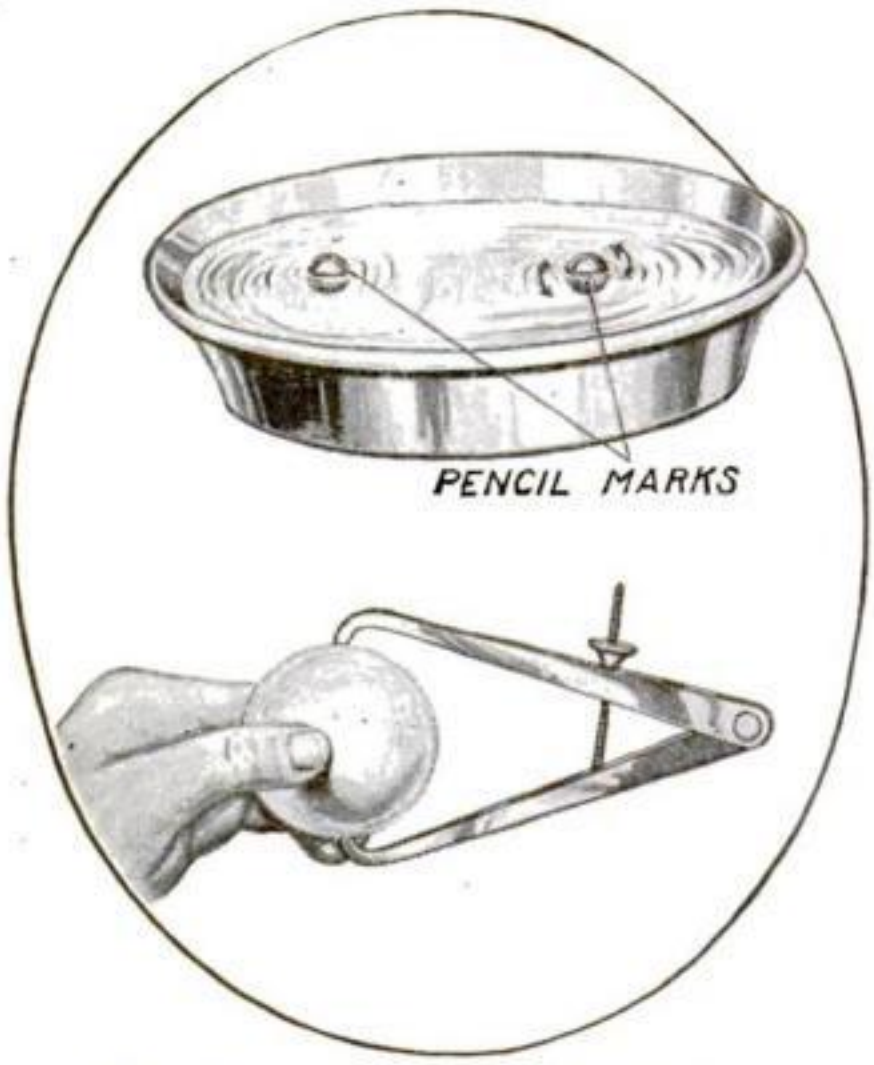
Within the shell there is a dry battery connected to a contact point and to one end of a platinum glow wire embedded in the fulminate. The other end of the glow wire is connected to an insulating lever carrying a contact point. This lever member is a closed hollow tube containing a little mercury, which, flowing to the lower end, tends to keep the lever down. A tube in the perforated cover contains a bucket filled with a dry sponge.

When once the bomb has struck the water and the sponge has sufficiently absorbed it, its weight bearing on the end of the lever member raises this lever into contact with the terminal, thus completing the circuit and discharging the fulminate.

There are several very obvious objections to a bomb of the type described. It is very difficult to hit an object on the ground when the aeroplane is very high. Indeed, no satisfactory instrument has thus far been invented to drop bombs from great heights with anything like the precision that marks the firing of projectiles from great guns. If the aeroplane is to destroy a submarine in the manner proposed, the bomb-dropper must be very near its target—so near that it would itself be in danger from gun fire.

Some of the difficulties of dropping bombs accurately spring from the fact that an aeroplane moves through the air at a rate of at least forty-five miles an hour. Allowance must be made not only for that forward movement, but also for the movement of the submarine as well as for the wind. A hit would therefore be almost a matter of luck.

Ferreting Out the Secrets of the Golf Ball



Two Tests to Determine Whether or Not a Golf Ball is "Lop-Sided"

WHAT is the most efficient type of golf ball? A well-known British scientist and golf enthusiast has made some exhaustive tests with golf balls of various sorts under various conditions. He finds that the average golf ball is altogether too rough and that the center of gravity is often misplaced. Accordingly, he experimented and the following rules are the result:

1. Float the ball in water until it becomes stationary. Mark it with a pencil and roll it slowly. If the mark comes up slowly the center of gravity is fairly accurate. If it comes up swiftly, the ball is "lop-sided."

2. Measure the ball at various points with calipers, to determine whether or not it is absolutely spherical.

3. Test one ball against another, for elasticity, by bouncing.

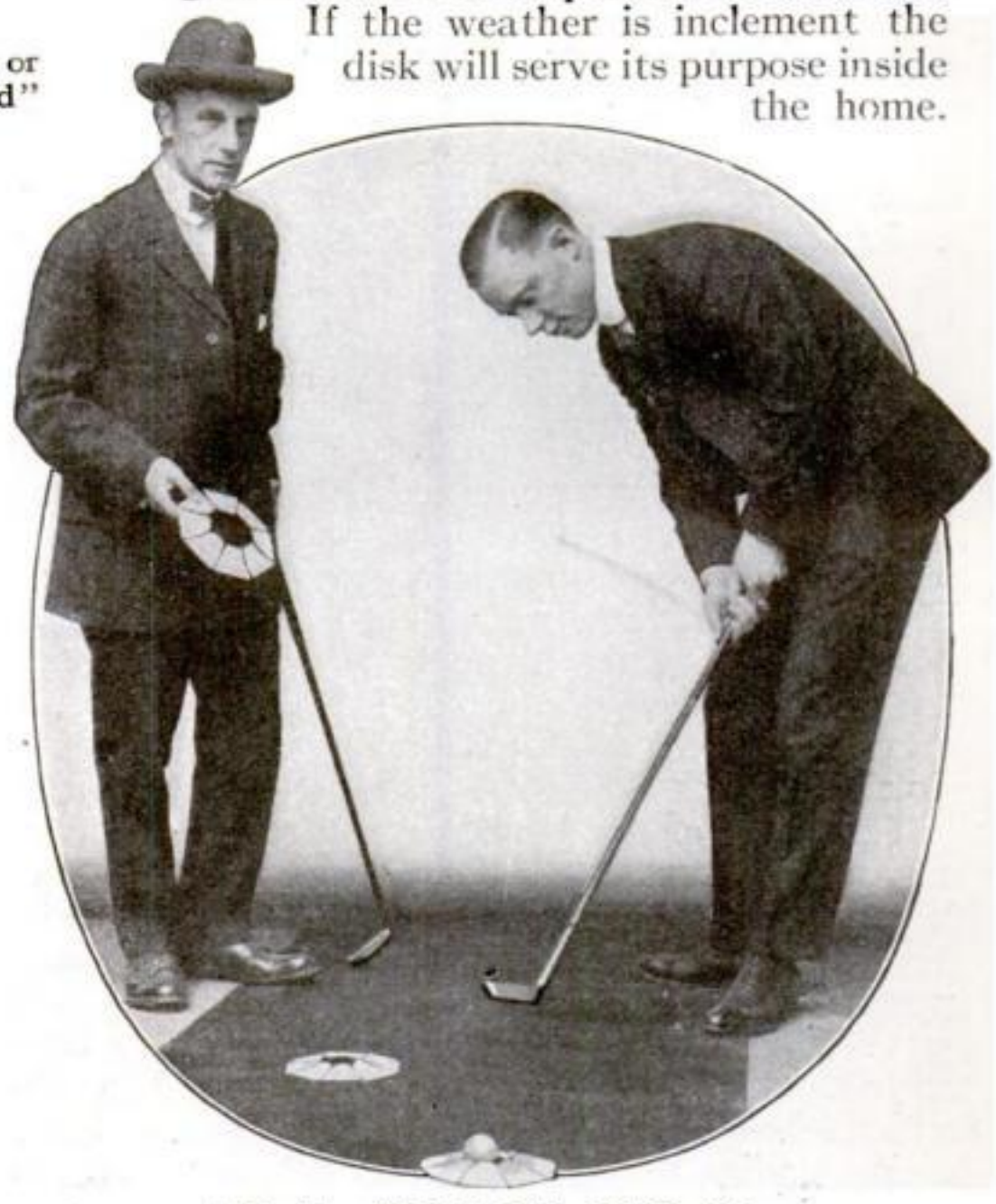
4. Throw the ball under examination straight up in the air in a heavy breeze. If bad, it will swerve.

5. Choose the smoothest ball.

A Metal Disk Supplants the Golfer's Tee

PRACTISING golf on the lawn at home is not as full of pleasure as it sounds, unless one cares to import enough sand or dirt to build the necessary tees. But where a metal disk is provided—a disk which takes the place of the accustomed tee and performs its duty with every degree of thoroughness, it is possible for the golfer to continue his practice without inconvenience.

The disk illustrated is very light. At the same time it is serviceable. The player can utilize it in two ways. He can substitute it for a dirt or sand tee, or consider it a hole and improve his putting thereby. With the disk it is not necessary for the golfer to confine his practice to the lawn. If the weather is inclement the disk will serve its purpose inside the home.



A Feather-Weight Disk Which Takes the Place of the Accustomed Tee

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Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Golfing by the Clock—A New Idea for Golf Courses

The Clock on Its Pedestal Is Located Where It Can Be Easily Seen from Club House and Course

A NOVELTY in the way of a holder for the golf course clock has made its appearance on the grounds of the Annondale Golf Club in Los Angeles, California.

This is a conspicuous all-concrete structure, standing about eight feet in height. The case containing the clock is two feet wide, two feet in height and a foot and a half in depth. Its walls are about three inches in thickness. A removable piece of plate glass occupies the front side of this case, while in the rear there is a small door through which the clock may be regulated. The standard is solid and is about a foot in thickness at the base and eight inches in diameter at the point where it meets the bottom of the case.

This clock and its holder are located beside Tee No. 1 of the course. It can be easily seen by those who are about to start upon a round of the course, as well as from all parts of the club house, from which it is a few yards distant.

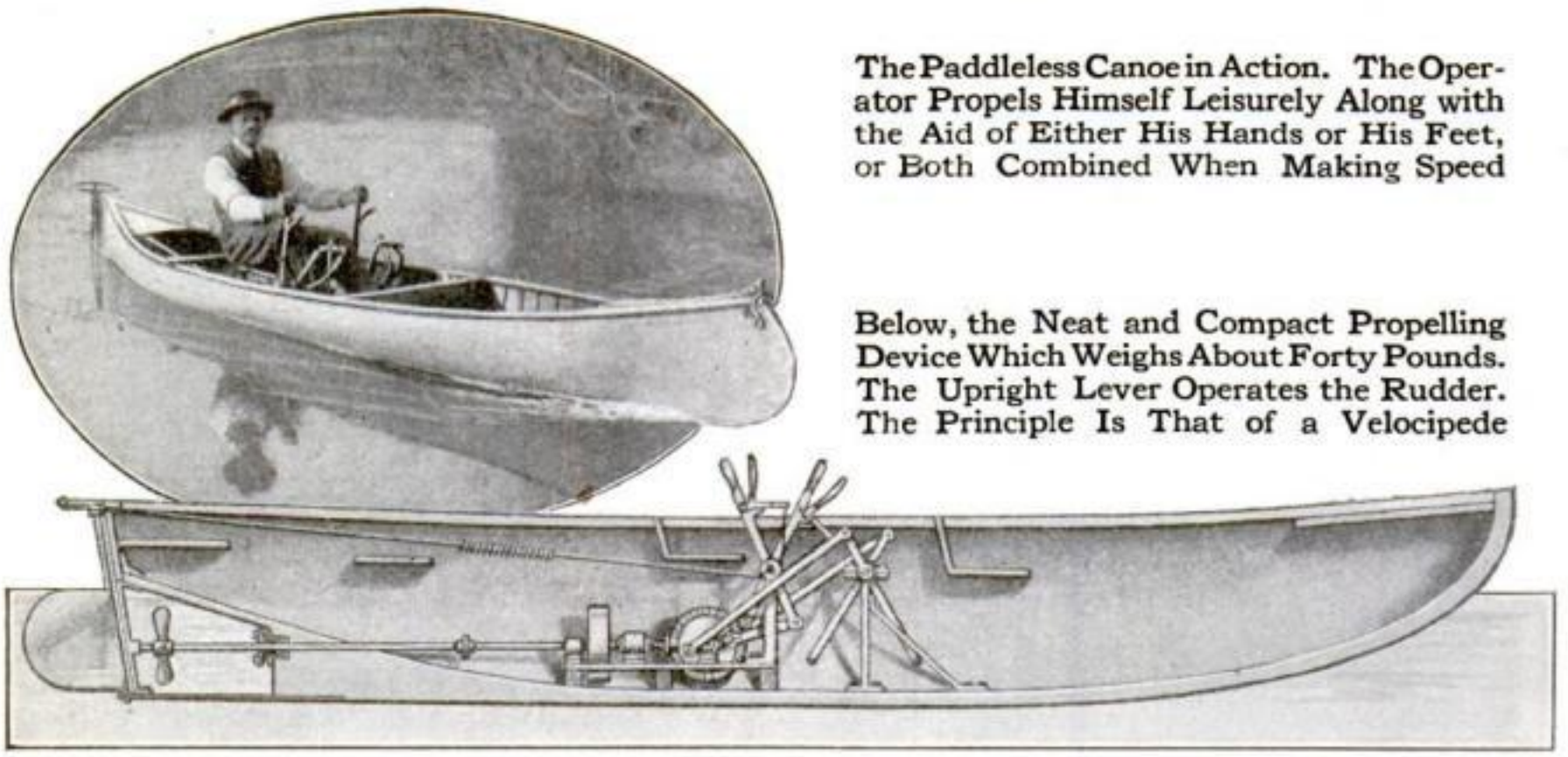
What Golfing Sometimes Does to the Feet

A SPECIAL "jinx" of the old golfer has been classified as "golfer's foot." It is a condition due to broken or fallen arches. When playing golf the anterior portion of the foot, in right-handed players, and vice versa in left-handed players, is brought into unusual service. As the drive is made the weight of the body is brought back with great force upon the foot that has been elevated in the up-swing. The greater part of the force is caught by the outer portion of the foot and inevitably the strain will be felt, especially if care is not taken at the beginning of the season to keep the feet in good condition.

Making Your Head Behave While You Hit the Ball

A DEVICE to make the golfer keep his head still while making a shot has been invented by Arthur E. Peck, of Minnesota. It consists of a sight that is suspended by a rod fastened to the front of the player's cap.

The Sight Makes the Player Keep His Head Still When He Swings to Hit the Golf Ball



The Paddleless Canoe in Action. The Operator Propels Himself Leisurely Along with the Aid of Either His Hands or His Feet, or Both Combined When Making Speed

Below, the Neat and Compact Propelling Device Which Weighs About Forty Pounds. The Upright Lever Operates the Rudder. The Principle Is That of a Velocipede

A Paddleless Canoe Propelled by Feet and Hands

WHEN George D. Sicklesteel, of Oregon, goes for a sail with his little canoe he forgets all about the rising cost of gasoline and engine trouble and propels himself up and down stream with a hand and foot-operated boat of his own construction.

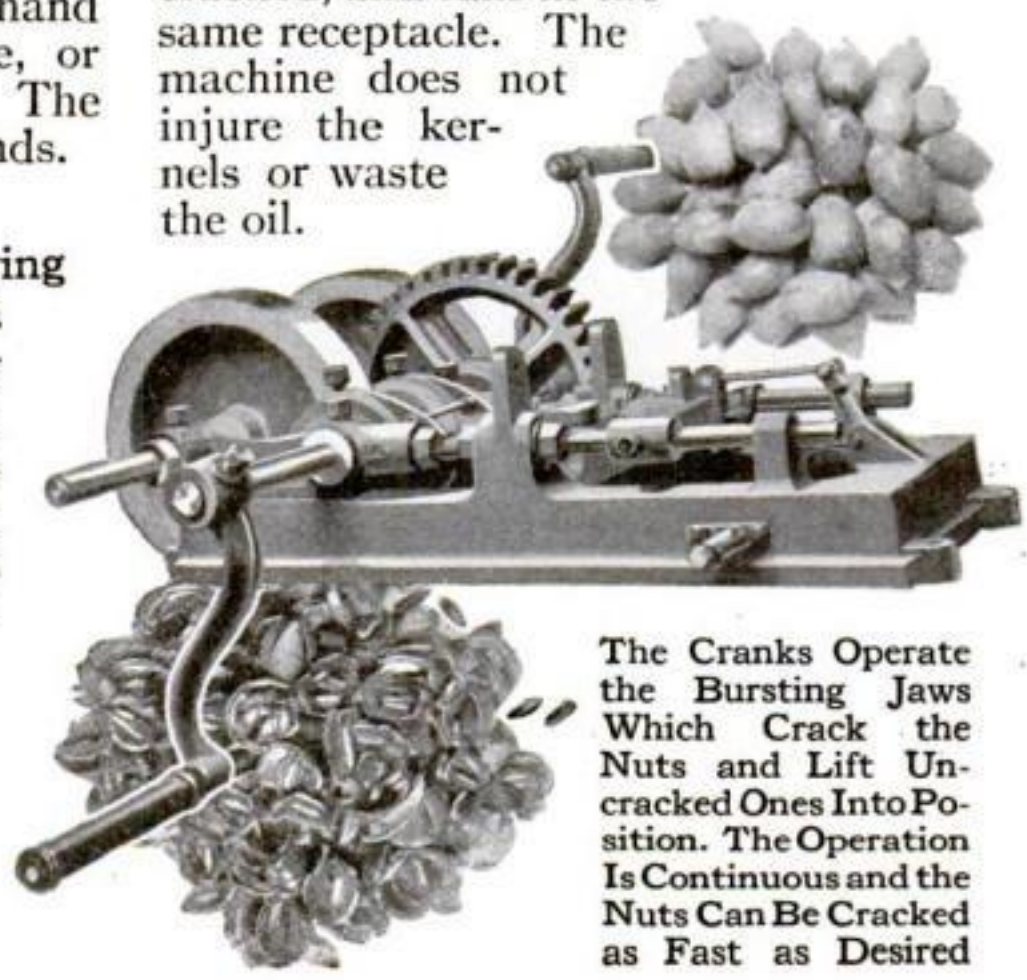
The hand levers are connected with a crank which carries a gear, and this meshes with another gear which drives the propeller shaft.

Pedal cranks are connected with the same crank which is operated by hand levers, so that the boat can be driven by foot as well as by hand-power. In this way the operator can use either one hand or two hands, or both feet alone, or both hands and feet together. The apparatus weighs about forty pounds.

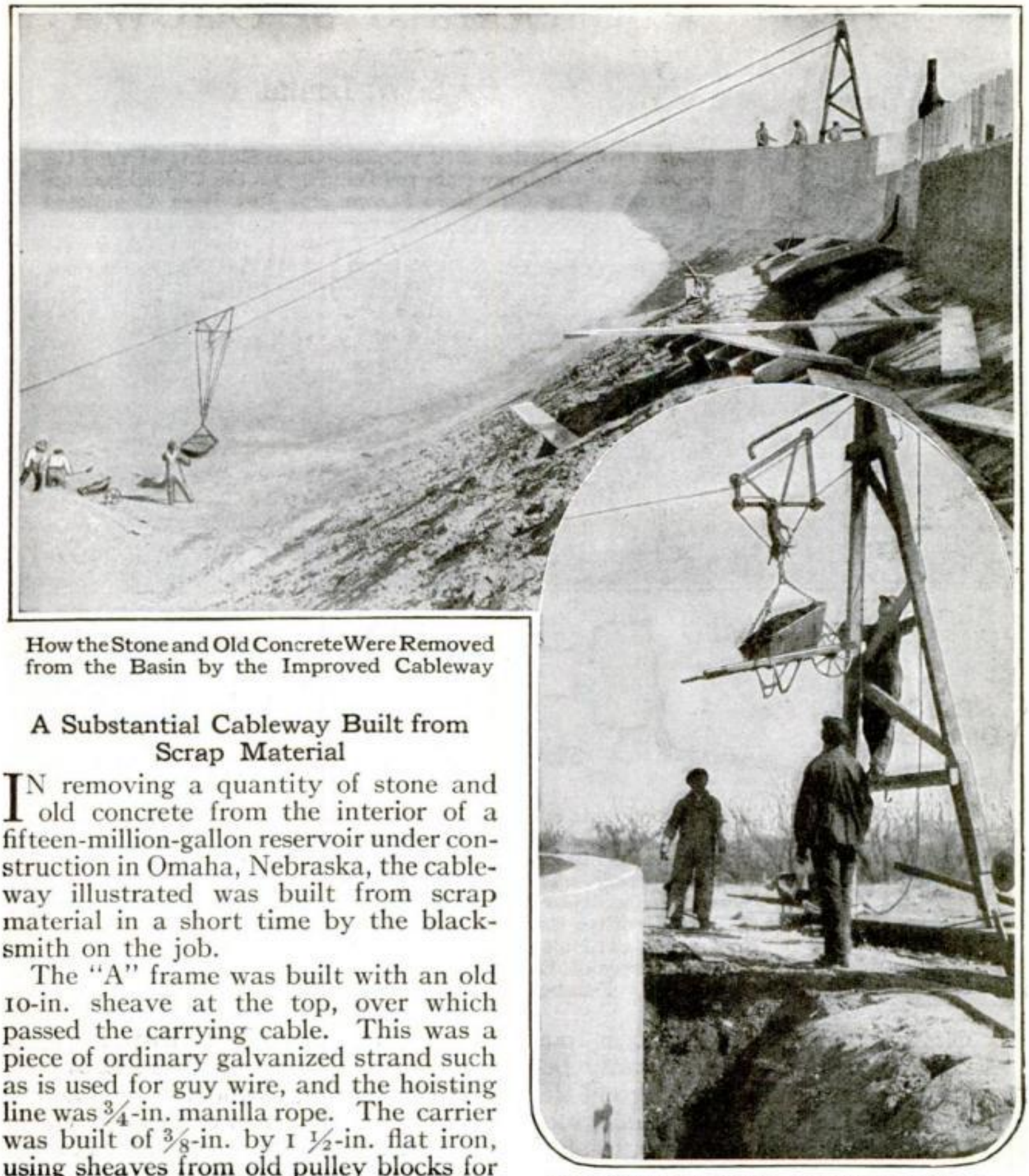
A Machine That Cracks Oil-Bearing Nuts Without Crushing Them

THE bursting and cracking of cocoanuts, cohune nuts and nuts of similar nature to enable the oil-bearing kernels to be extracted with the least possible waste has long been a tedious hand process. A machine has been invented by an English firm, which is said to crack the nuts more quickly and with less waste than any apparatus heretofore devised. The pressure is applied to the nuts lengthwise, and each nut is placed in a position between the bursting jaws, hollowed out so as to safely hold the "nose" or rounded part, and is there cracked. As fast as one is cracked another is lifted in position, so that the operation is continuous. The operator simply turns the crank, and the nuts are cracked as fast as they are fed to the bursting jaws.

Below the machine is a hopper containing the supply of nuts. A belt carrying lifting forks enters this hopper and lifts the nuts one by one to the bursting jaws. One revolution of the driving shaft, operated by the crank, crushes a nut, which falls in a receptacle. At the same time another nut is brought in position, is cracked, and falls in the same receptacle. The machine does not injure the kernels or waste the oil.



The Cranks Operate the Bursting Jaws Which Crack the Nuts and Lift Uncracked Ones Into Position. The Operation Is Continuous and the Nuts Can Be Cracked as Fast as Desired



How the Stone and Old Concrete Were Removed from the Basin by the Improved Cableway

A Substantial Cableway Built from Scrap Material

IN removing a quantity of stone and old concrete from the interior of a fifteen-million-gallon reservoir under construction in Omaha, Nebraska, the cableway illustrated was built from scrap material in a short time by the blacksmith on the job.

The "A" frame was built with an old 10-in. sheave at the top, over which passed the carrying cable. This was a piece of ordinary galvanized strand such as is used for guy wire, and the hoisting line was ¾-in. manilla rope. The carrier was built of ⅜-in. by 1 ½-in. flat iron, using sheaves from old pulley blocks for the running and hoisting sheaves. The movable block, to which was attached the hook for suspending the load, was an 8-in. block with a long pin through the sheave to engage the stop on the carrier when the tackle was at "two-block." The wheel-barrows were attached by a three-chain grab.

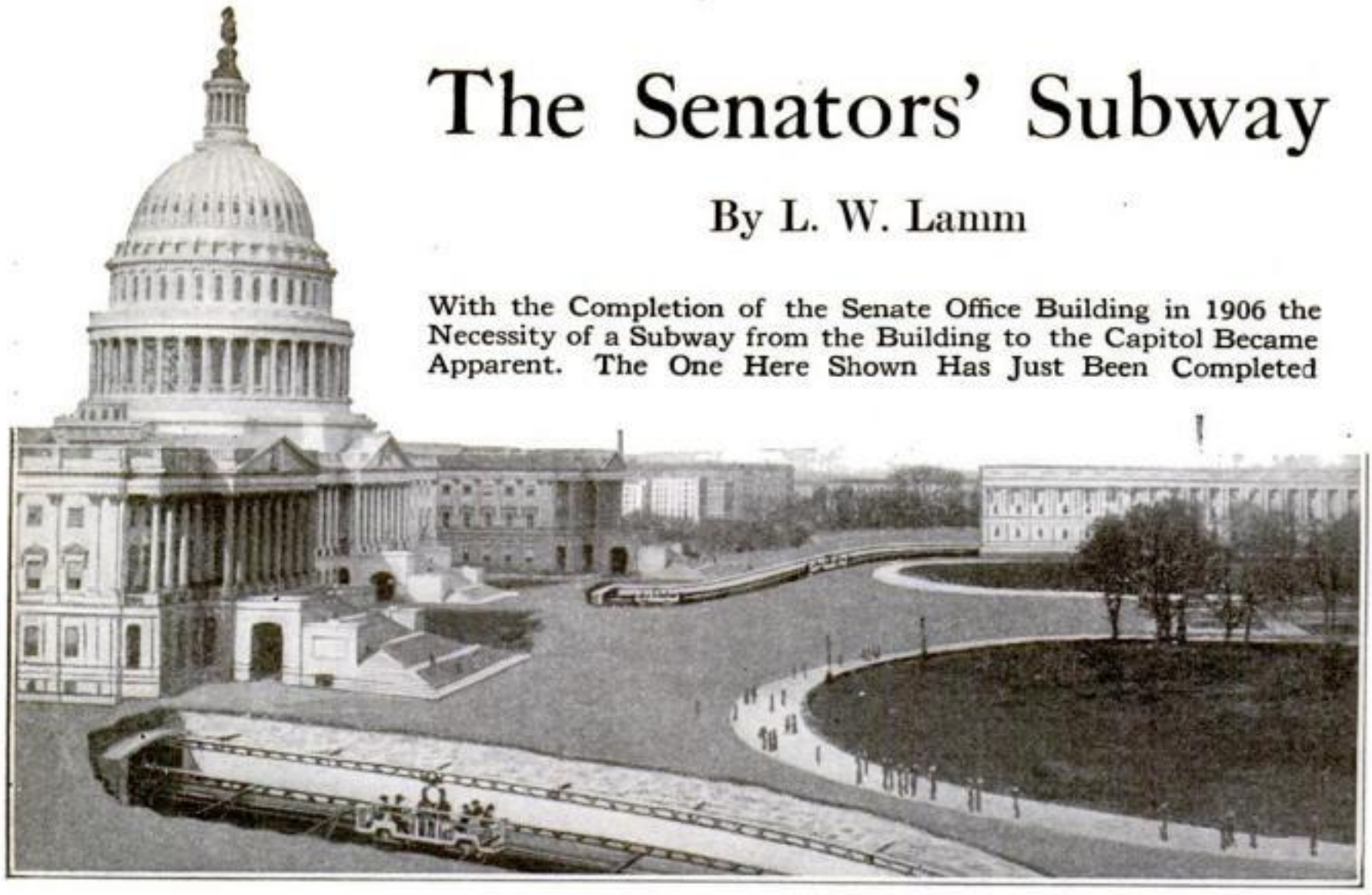
With the cableway in operation, the wheel-barrows were loaded inside the basin, wheeled under the lower stop of the cableway and the grab chain attached. The load was raised by a hoisting line to the "two-block" position, and then hauled up on the carrier line. Upon reaching the head frame the long hook was dropped to engage a pin in the top member of the carrier. When the hoisting line was released the wheelbarrow was lowered to the ground. The grab chains were released and the load wheeled to the dump. An empty wheelbarrow was then attached, hoisted to the carrier, the hook released and the load sent to the floor of the basin. On this work a small hoisting engine was used.

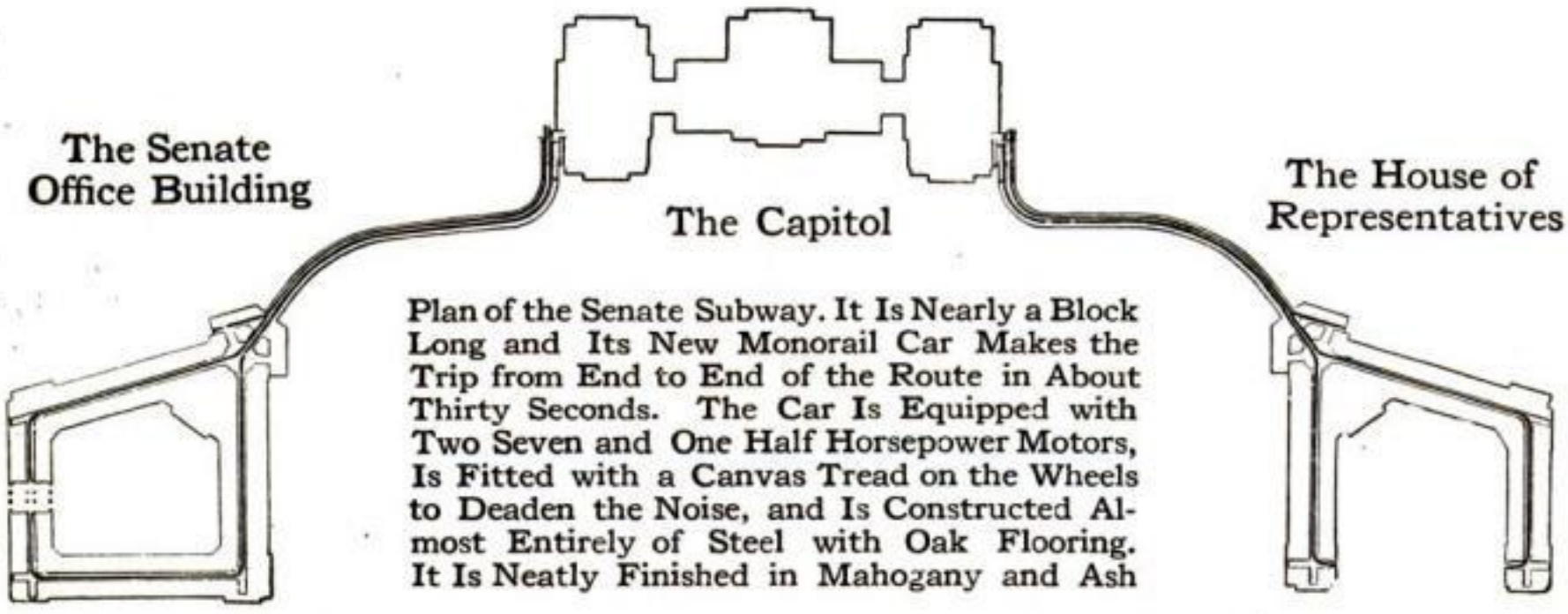
Releasing the Hoisting Line at the "Two-Block" Position Lowered the Wheel-Barrow

The Senators' Subway

By L. W. Lamm

With the Completion of the Senate Office Building in 1906 the Necessity of a Subway from the Building to the Capitol Became Apparent. The One Here Shown Has Just Been Completed





Plan of the Senate Subway. It Is Nearly a Block Long and Its New Monorail Car Makes the Trip from End to End of the Route in About Thirty Seconds. The Car Is Equipped with Two Seven and One Half Horsepower Motors, Is Fitted with a Canvas Tread on the Wheels to Deaden the Noise, and Is Constructed Almost Entirely of Steel with Oak Flooring. It Is Neatly Finished in Mahogany and Ash

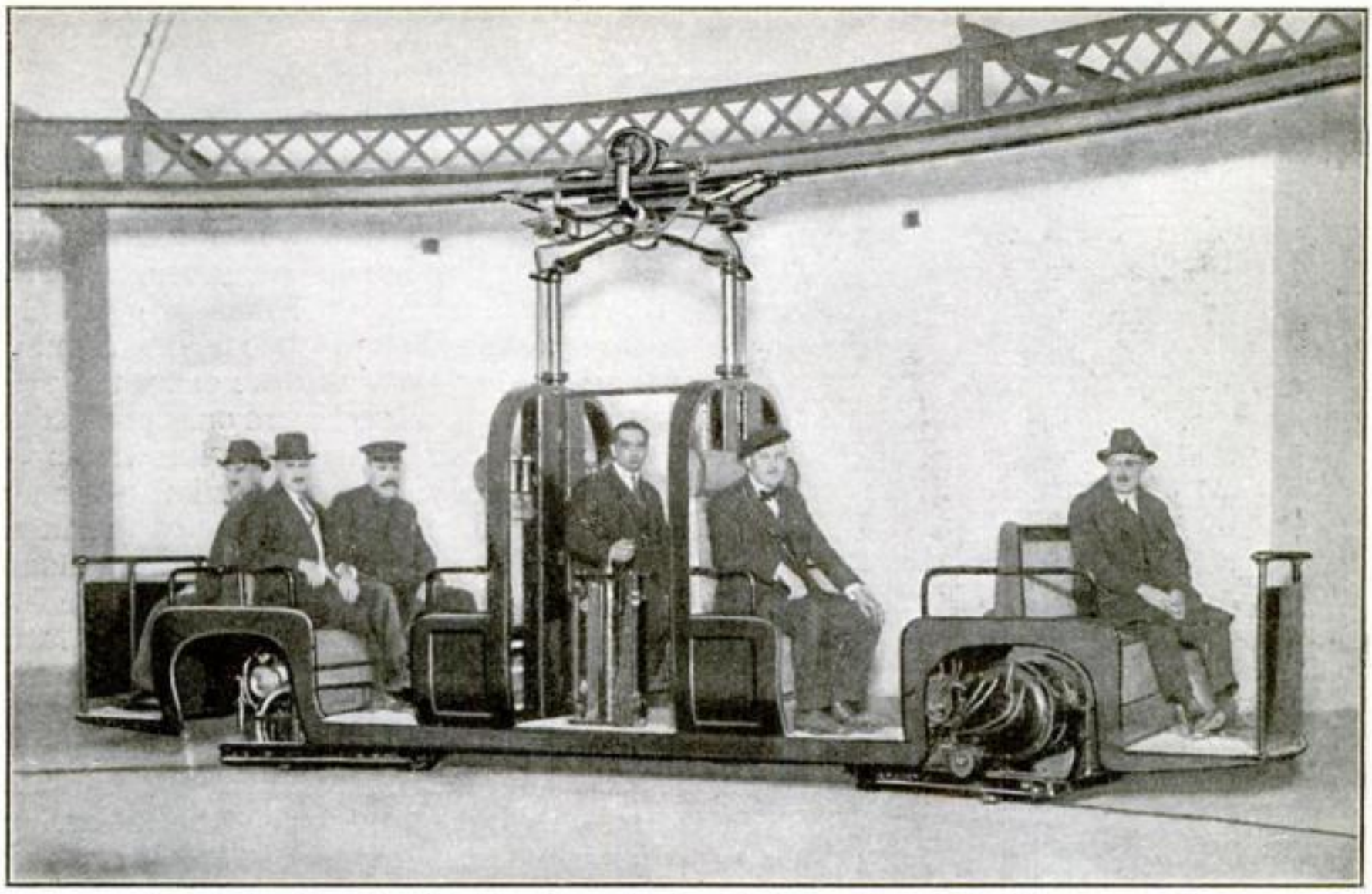
A NEW monorail car has been put into operation in the subway between the Capitol building and the Senate Office Building, at Washington, D. C. A car of similar construction has been in service up to now, but the old car was slow and seated only twelve persons. This new car, which was designed and built under the direction of the office of the Superintendent of the Capitol, Elliott Woods, has a seating capacity of eighteen, makes faster time and is less noisy.

Built for the most part in the machine shops of the Washington Navy Yard, the new car makes about one hundred and twenty-five round trips a day in the tunnel, on what is perhaps the shortest railway in the country, seven hundred and fifty feet long. The car weighs two thousand five hundred pounds, is eighteen and a half feet over all and forty-six inches wide.

One of the features of the new car is the seat for the "motorman." He sits in the center, and without getting out of his place, makes the car go either way. This, in itself, is a time saver. It is estimated that the car can make twenty-five miles an hour. It takes just thirty seconds to go from one end of the subway to the other.

The car is equipped with two seven and one half horsepower motors, is fitted with a canvas tread on the wheels to deaden the noise, and is constructed almost entirely of steel with oak floors. It is finished in mahogany and ash.

In 1906 when the Senate Office Building



The New Car Has Seating Capacity for Eighteen Men. The Motorman Sits in the Center and Does Not Have to Change His Position to Reverse the Car

was just about completed it was decided that a "subway" under the parking between the Capitol and the building was a thing to be desired. Behold, it was done. It is nearly a block long. At first the Senators were satisfied to walk. That was too slow, especially when they were hurrying to the Senate chamber from their offices to vote. An electric automobile, with a capacity of about twelve persons was then installed. This was well enough for a while, but even this was slow. The monorail car was then put into operation, which has been fast enough up to now, but even that was slow and so the latest product has just been installed.

And It Looks So Small On the Map!

EVERY four years New York city takes unto itself a city the size of Boston or St. Louis.

New York is the largest Jewish city in the world. It is the largest Irish city, there being 674,721 of Irish blood here. There are 723,333 Germans, 306,422 Austrians and 735,477 Russians.

There are 3,087 miles of water pipes under the city; the capacity of the reservoir is 170,000,000,000 gallons, and the conclusion of the Schoharie project will add 80,000,000,000 to this.

Every day 290,000 persons arrive or depart from the city through the railroad stations.

The railroad systems terminating in New York have a mileage of 45,323 miles, or 18 per cent of the total mileage of the country.

Every thirty minutes a new business corporation is formed in New York and every forty-five minutes one is dissolved.

Every four minutes a new being is born, to have the proud distinction of being a native New Yorker. Babies to the number of 150,000 were born there last year.

New York has 38,000 factories. They employ capital amounting to $1,800,000,000 and turn out $2,900,000,000 worth of goods a year.

Every day the traction facilities carry 4,967,680 persons.

The city has 198 parks, with an acreage of 8,615. It has 1,500 hotels. More than 500 conventions are held there a year. There are thirty-one post offices.

Making the Scallops on Plate Glass

The Tool Grasps the Edge of the Glass Plate and Bites It Off With a Tooth or Point

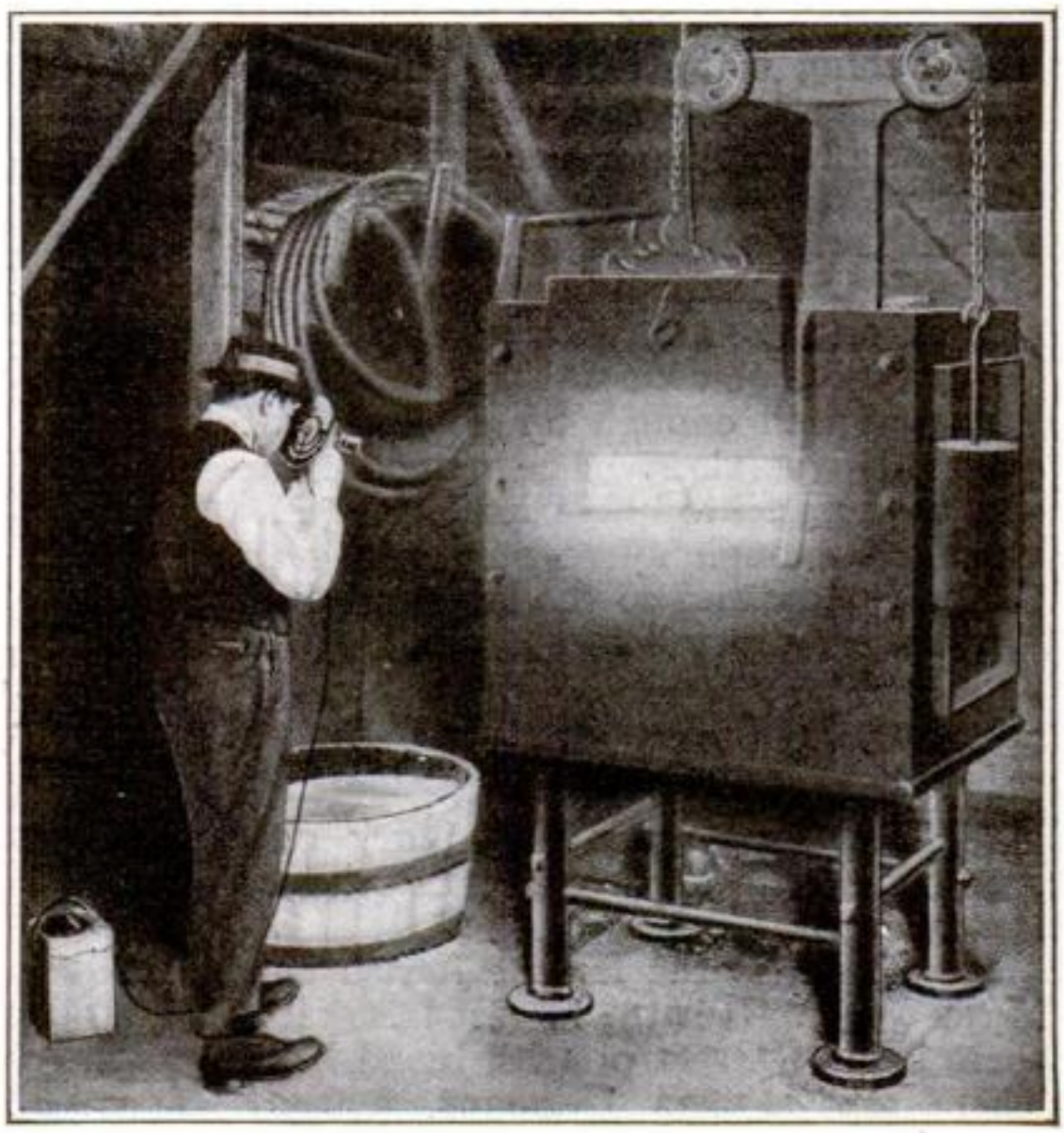
WILLIAM SPANGLER, a resident of Illinois, has invented an improved glass-chipping tool which has for its purpose the ornamentation of plate glass by scalloping. The ordinary glass-chipping tool can be used on glass of one thickness only, and when a plate of another thickness is to be chipped another tool must be employed. The tool grasps the edge of the plate between a bearing point and a bit and bites it off with a tooth, or point, provided for the purpose. In order that the same tool may operate successfully with varying thicknesses of glass it is necessary that the space between the bearing point and the bit be adjustable in two directions—transversely of the edge of the glass and longitudinally of the handle of the tool, so that the bearing point shall impinge the glass at varying distances from the edge.

The invention referred to provides for this double adjustment of the jaws.

How Heat Is Measured with the Eye

NOW that man has succeeded in obtaining artificial heats that almost rival the intensity of the sun, the accomplishment has made the demand upon him that, in harnessing this terrific heat for industrial purposes, he shall devise some means of measuring it. For many years after electric heat was known and used industrially the exact temperatures which existed were only guessed at. Recently, an instrument known as the thermo-electric pyrometer has come into use, but this ingenious type of thermometer has the serious limitation that it will melt when the temperature has passed a certain point. The latest development in heat-measuring devices is an optical instrument, which, while it is placed in operation many feet from the heat source, will measure the temperature with a fine degree of accuracy.

The "sight pyrometer," as it might be called, really takes up the measurement of temperatures where the ordinary pyrometer leaves off. It can safely and accurately measure heat at temperatures as high as 7200 degrees Fahrenheit. The

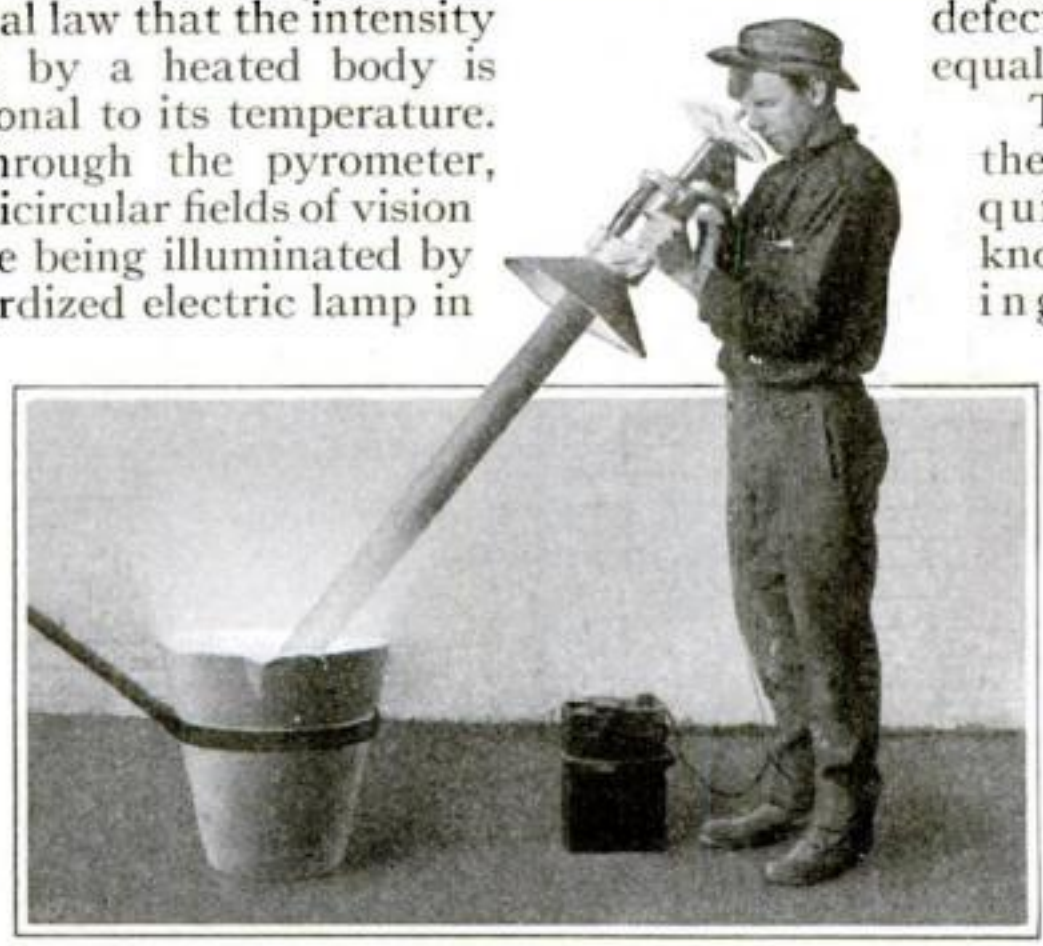


Measuring Heat-Treating Temperatures With the "Sight Pyrometer" Many Feet from the Heat Source

minimum temperature it will record is 1200 degrees.

The principle upon which the operation of the sight pyrometer is based is the simple physical law that the intensity of light emitted by a heated body is directly proportional to its temperature.

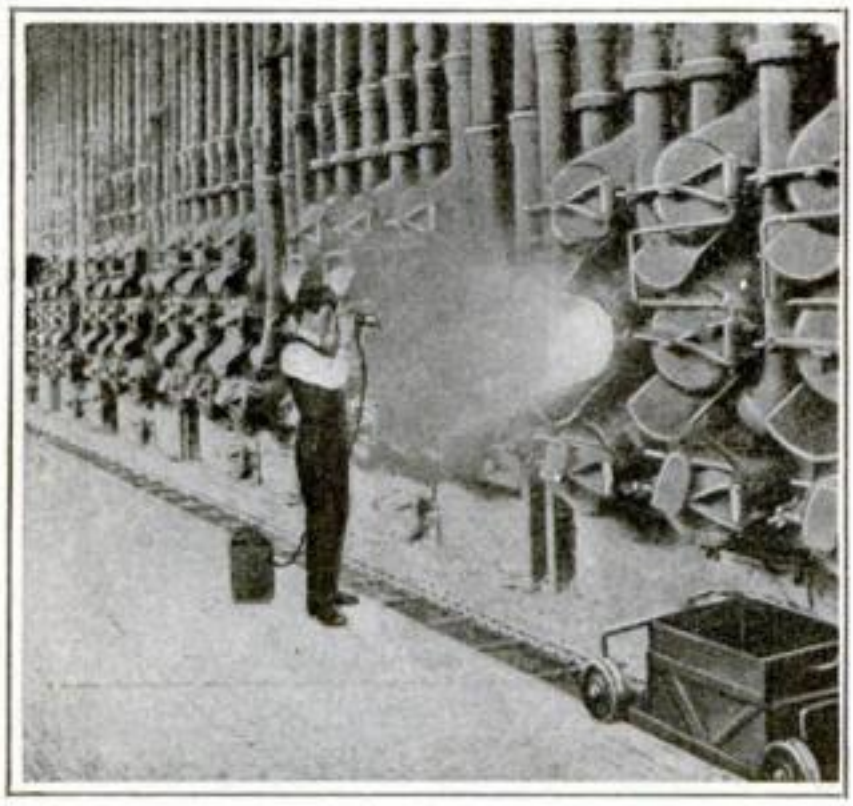
In looking through the pyrometer, two adjacent semicircular fields of vision are observed, one being illuminated by the small standardized electric lamp in the pyrometer and the other by the object whose temperature is to be measured. The red ray of the spectrum is used and very slight differences in the intensity of the heat in the object under investigation produce quite perceptible differences in the shade.



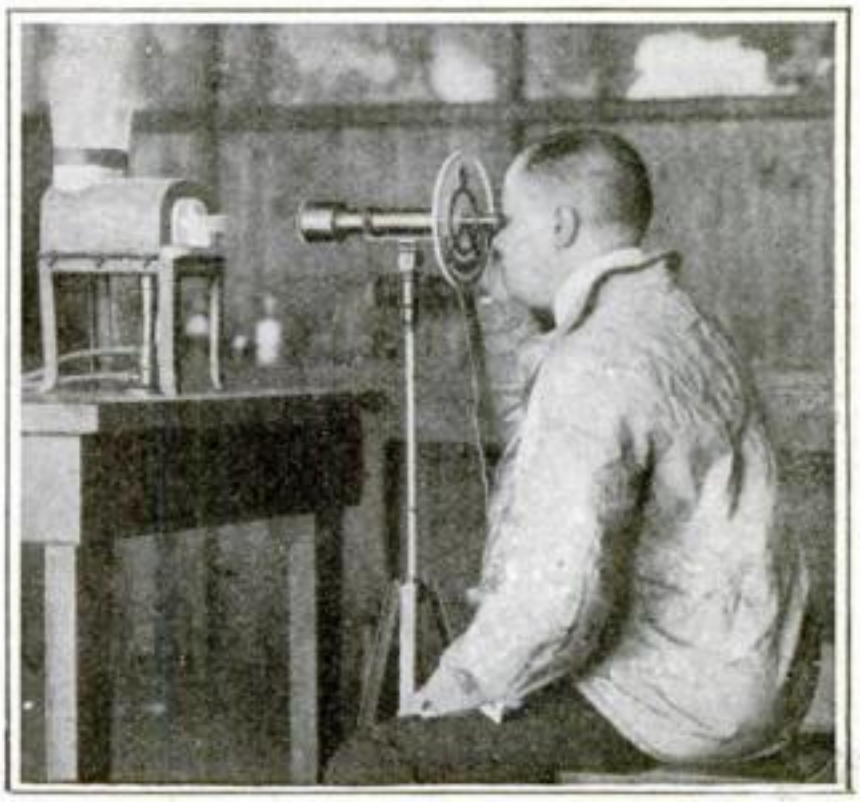
Measuring the White Heat of Molten Minerals. The Shield Protects the Hands of the Operator. The Instrument Also Measures the Heat of Moving Bodies

In taking readings, the intensity of the field illuminated by the lamp is adjusted by turning the eye-piece until the line separating the two fields is eliminated, and the corresponding temperature is read directly from the dial. The matter of bringing both fields of vision to correspond is not a personal one of matching colors. There is always a line between the two fields when they do not correspond; therefore, it is simply a matter of eliminating this line, and any defects of vision are equalized.

The handling of the pyrometer requires no special knowledge, and readings within ten degrees of each other can be made by any workman of average intelligence. In making observations the temperature of the object itself is measured. It is this temperature and not the heat of the furnace that determines whether the object is being treated at the proper temperature to produce the effect desired. For metallurgical operations the ideal pyrometer never comes in contact with the heated object—in fact, no heating of the instrument is required, and the readings are taken almost instantaneously. It can also measure heated moving bodies.



The Intensity of Light Emitted by a Heated Body, Regardless of Size, Is Directly Proportional to Its Temperature

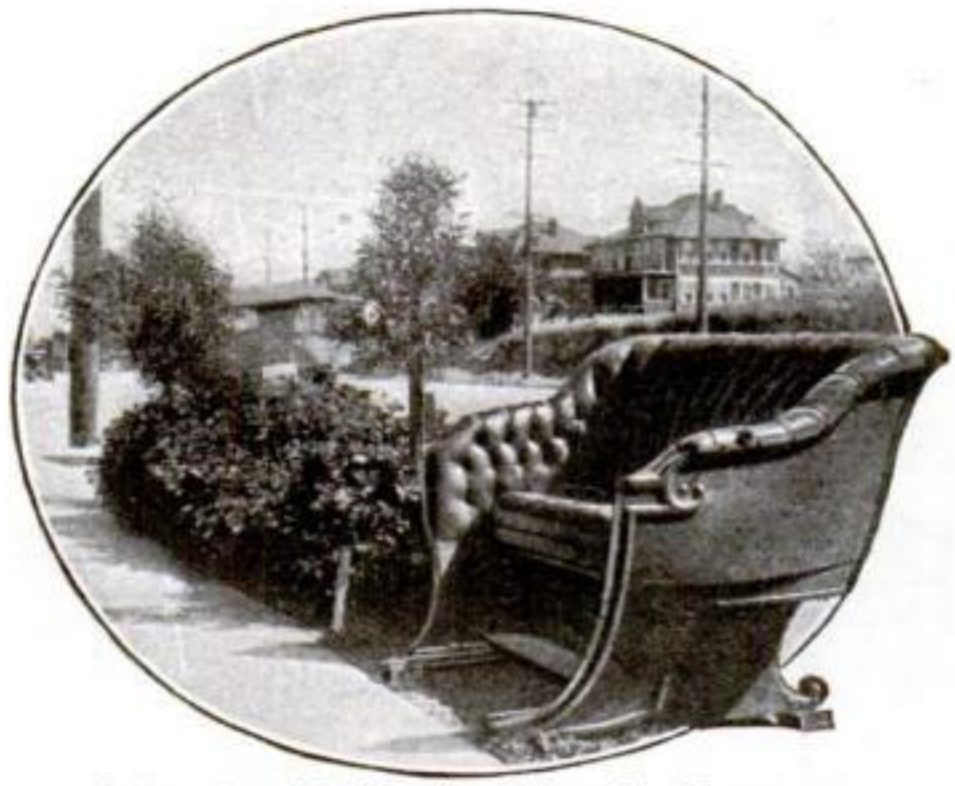


In Looking Through the Pyrometer Two Adjacent Semicircular Fields of Vision Are Observed with the Operator's Eye

This Automobile Seat Serves as a Waiting Room

A REAL estate man of Los Angeles, California, has found a new use for the rear seat of a worn-out automobile. He came into the possession of an automobile which was ready for the junk pile.

Realizing his immediate need of a resting place for the patrons who visited his little office he saw that some other place must be provided if his customers were to be well taken care of. He thought of the old automobile war horse that stood in his back yard. After some consideration he decided that the rear seat of that "tub" was just what he wanted. So, he took it down and planted it in the parkway directly in front of his office. And there it is now in royal dignity.



A Comfortable Resting Place for Customers Waiting Outside This Dealer's Office for a Car

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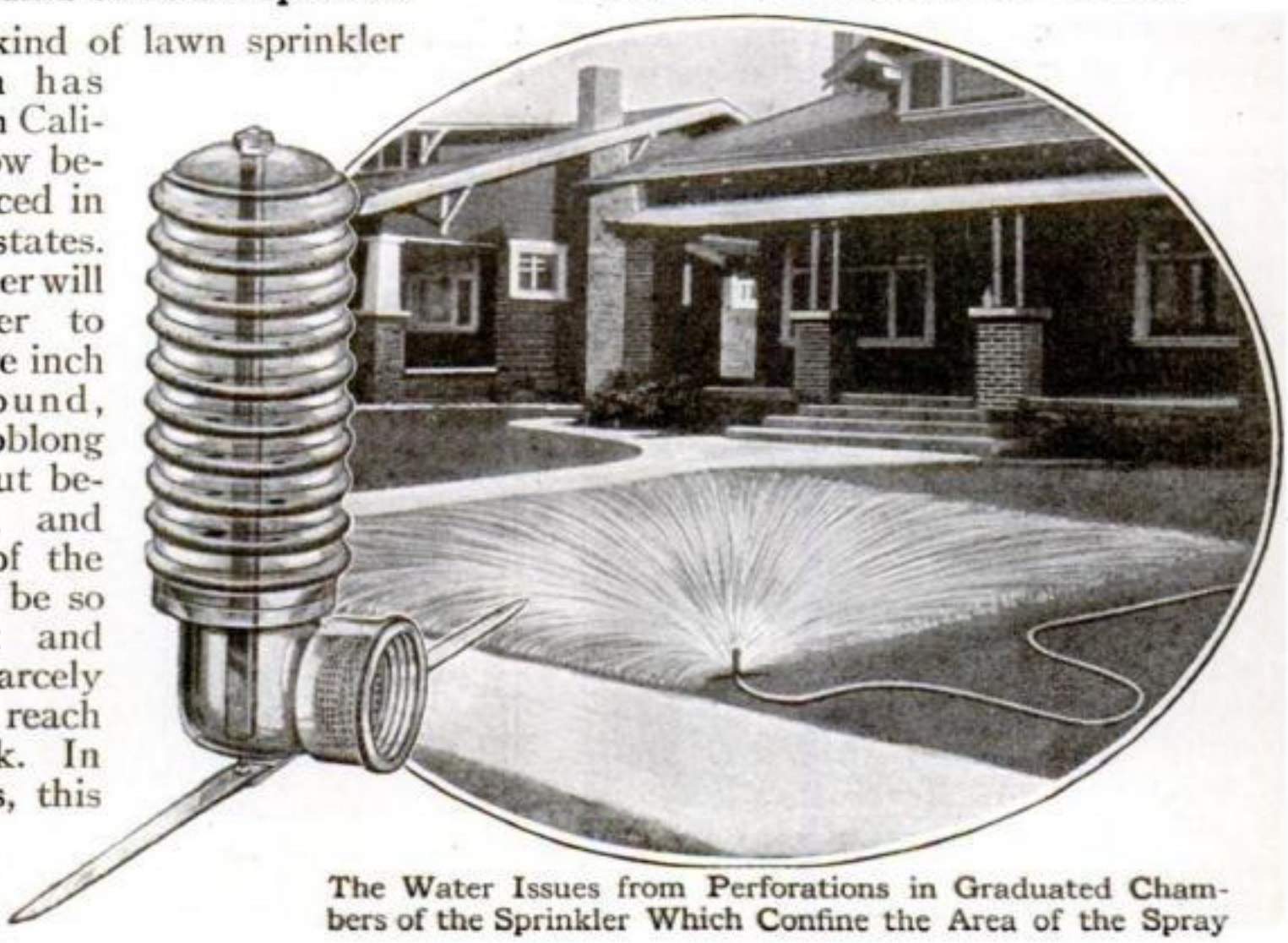
New Kind of Lawn Sprinkler

A NEW kind of lawn sprinkler which has won favor in California is now being introduced in the eastern states. This sprinkler will apply water to every square inch of any round, square or oblong lawn without being moved and the edges of the stream will be so straight-cut and even that scarcely a drop will reach the sidewalk. In other words, this sprinkler will throw a solid square or circle of water, which can be confined exactly to a given area, large or small. The device is so small that it can be carried in the pocket, but it covers eight hundred square feet of lawn surface, if the water pressure is good enough.

One kind is required for a square lawn, however, another kind for a round lawn and still another when the shape is oblong. A special sprinkler is also made for sloping ground. The sprinkler is placed at one side of the lawn when in use and can be moved about without wetting the one who is handling it. The peculiar effects of this sprinkler are obtained by means of several chambers one above the other. While the pressure in the first chamber is sufficient to carry the water to the farthest side of the lawn, in the last chamber it is only sufficient to throw the streams of water a few inches.



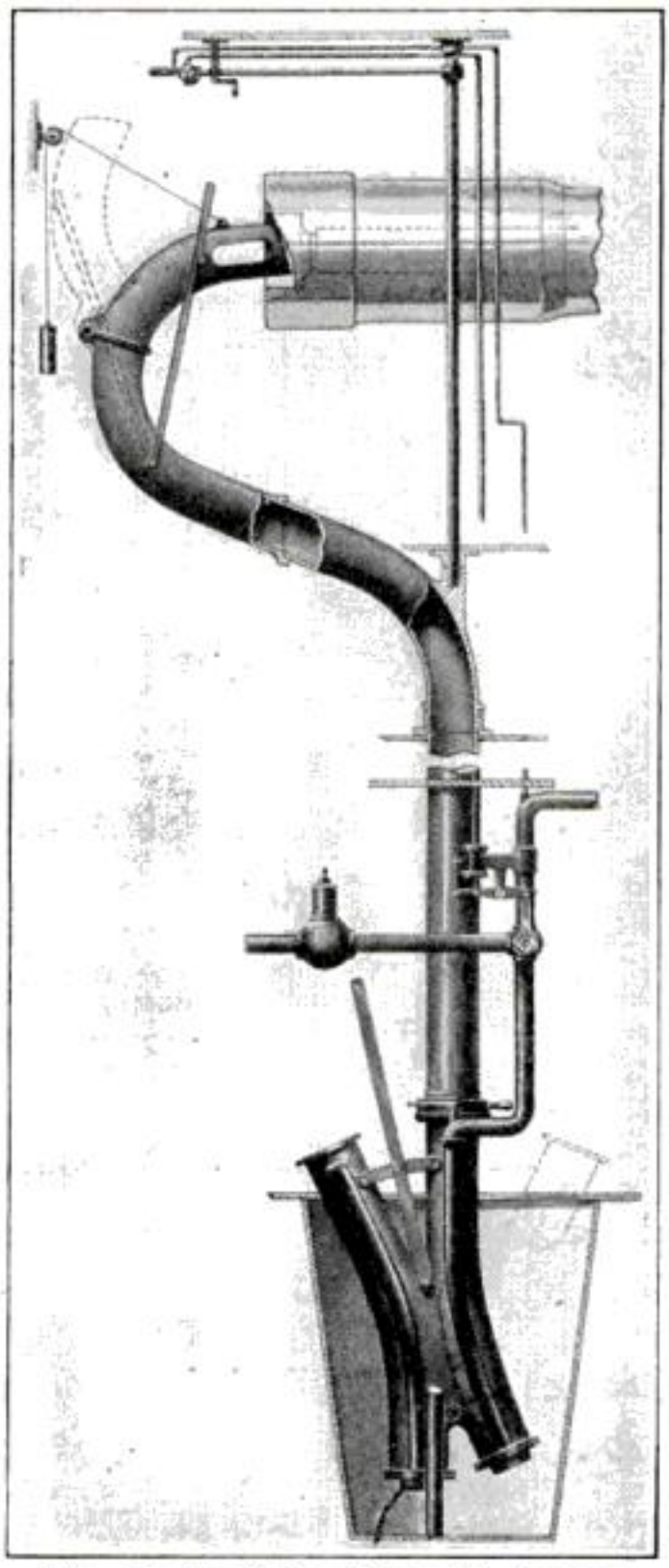
The Water Issues from Perforations in Graduated Chambers of the Sprinkler Which Confine the Area of the Spray

Loading Guns by Pneumatic Tube

FROM the days of the Spanish Armada down to the present time guns, big and little, on board men-of-war have been loaded by hand. Ammunition hoists have supplanted the tedious lifting processes of the past, but modern engineering progress seems to have left in the lurch any instrument which would automatically load the gun and thus do away with the human factor. However, a Massachusetts man has taken out patents on a pneumatic ammunition elevating and loading device which may solve the problem.

His device is particularly adapted for use on shipboard, and the object is to provide means under the control of the operator in the turret for elevating a charge from the magazine to the turret and to direct and drive the charge into the breech of the gun for firing, after the breech has been closed. The mechanism as installed would extend from a point adjacent to the magazine below the deck to a device located above the gun deck.

The complete elevating and loading system consists primarily of a transmission tube adjacent to the magazine which leads directly to the breech of the gun. The tube's lower section or despatching inlet is so adapted that two holders comprising the inlet may be brought into alinement with the tube by moving a lever fixed to the inlet. The air is supplied through a pipe which connects at one end with a reservoir where the supply of air is stored, and which will always be at constant pressure prior to sending a charge. As each holder is swung into position, or alinement with the transmission tube, an air-tight joint is made. When one holder is connected with the transmission tube and the charge is ready to be elevated to the gun, the other holder is in a position to receive a fresh supply of ammunition.



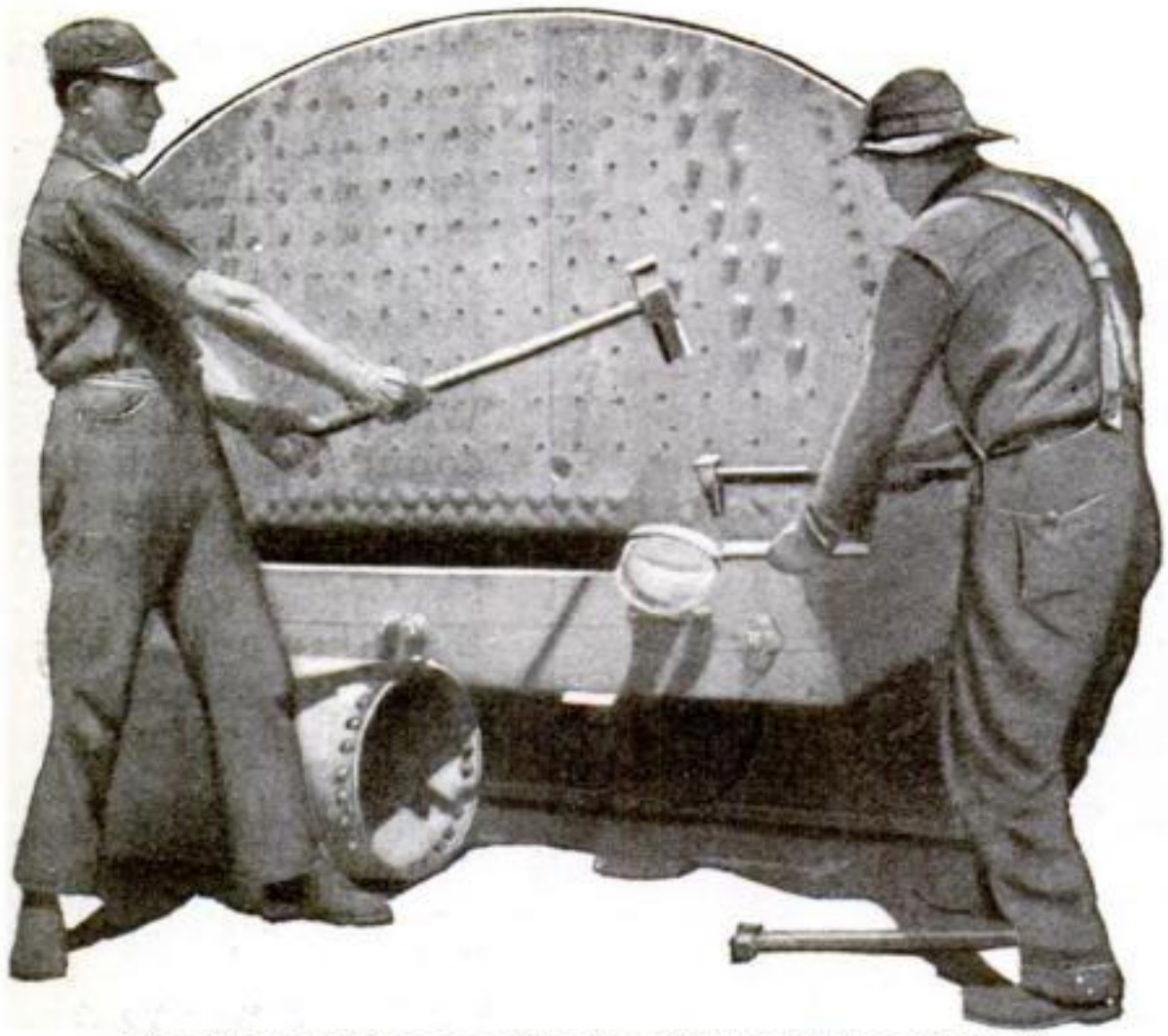
The Bend of the Tube Is Important as a Retarding Device to Deliver the Ammunition Gently and Without Shock into the Breech

Above the gun deck the main or transmission tube is pivoted at its lower end so that it may be swung to connect with either of the guns near it. The tube is curved to form a bend by which the ammunition is carried round to the breech of the gun and delivered horizontally into the gun.

When the tube is in position to deliver into the gun it is held firmly in position by means of a lever. A counterbalance connected with the tube sections facilitates their movement and holds them in any desired position. Within easy reach of the gunner is a valve which is operated to allow the charge of ammunition to be driven into the gun, but an automatic device makes this impossible unless the transmission tube is in alinement with the breech of the gun. A system of valve connections makes this possible.

By means of them the man in charge of the magazine will be unable to send any ammunition until the gunner is ready to receive it. When the gunner is ready he will turn the valve above his head which will allow the man in the magazine to send up the ammunition.

Bagging Rivet Heads with a Butterfly Net



The Metal Chips and Heads of Rivets When Cut Off Are Caught in Wire Baskets with Wooden Handles

CUTTING off rivet heads is a strenuous occupation. Bits of metal are likely to fly in unlooked-for directions, sometimes injuring bystanders very severely.

Safety engineers on the Southern Pacific Railroad figure that loose rivet heads flying around with the speed of bullets are not conducive to the general good health and well-being of employees or of the public.

Hence they have equipped all their rivet-cutting gangs with wire baskets mounted on long wooden handles. When using one of these devices, a rivet-cutter angles for the head when it comes off in much the same way as entomologists and youngsters seek to capture moths with butterfly nets—in fact, the rivet baskets and a professor's butterfly net look a good deal alike.

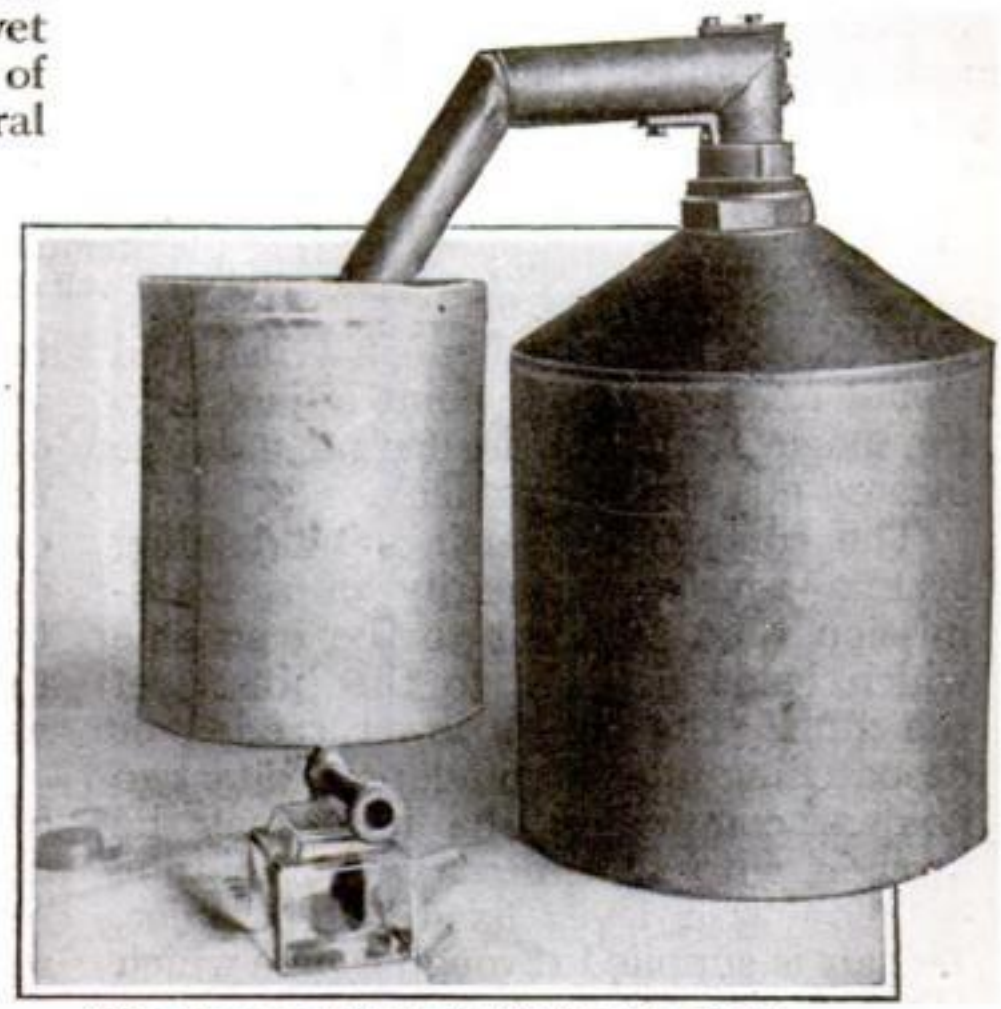
At any rate, the baskets have proved themselves to be a sure preventative of flying rivets; for they catch their prey before it has flown six inches—thus effectually stopping them in their dangerous flight.

Hungarian Nectar Still in Which Rhubarb Brandy is Made

IN the Pittsburgh office of the Federal Revenue Department there is an apparatus which might be called a home-made moonshine whiskey outfit if it had not been designed to distil drop by drop the Hungarian nectar known as "rhubarb brandy." The Hungarians drink rhubarb brandy with as much pride and genuine enjoyment as the Italians display when wrestling with spaghetti.

As the rhubarb brandy is supposed to be possessed of medicinal and health-building qualities, being laxative in its action rather than abnormally stimulating in its effects, those who hold it in high regard may object to its being classified with whiskies in general. However, it is made in much the same way.

The still by means of which the brandy is made is a copper kettle sealed at the top with the customary "goose neck," and it was confiscated as illicit.



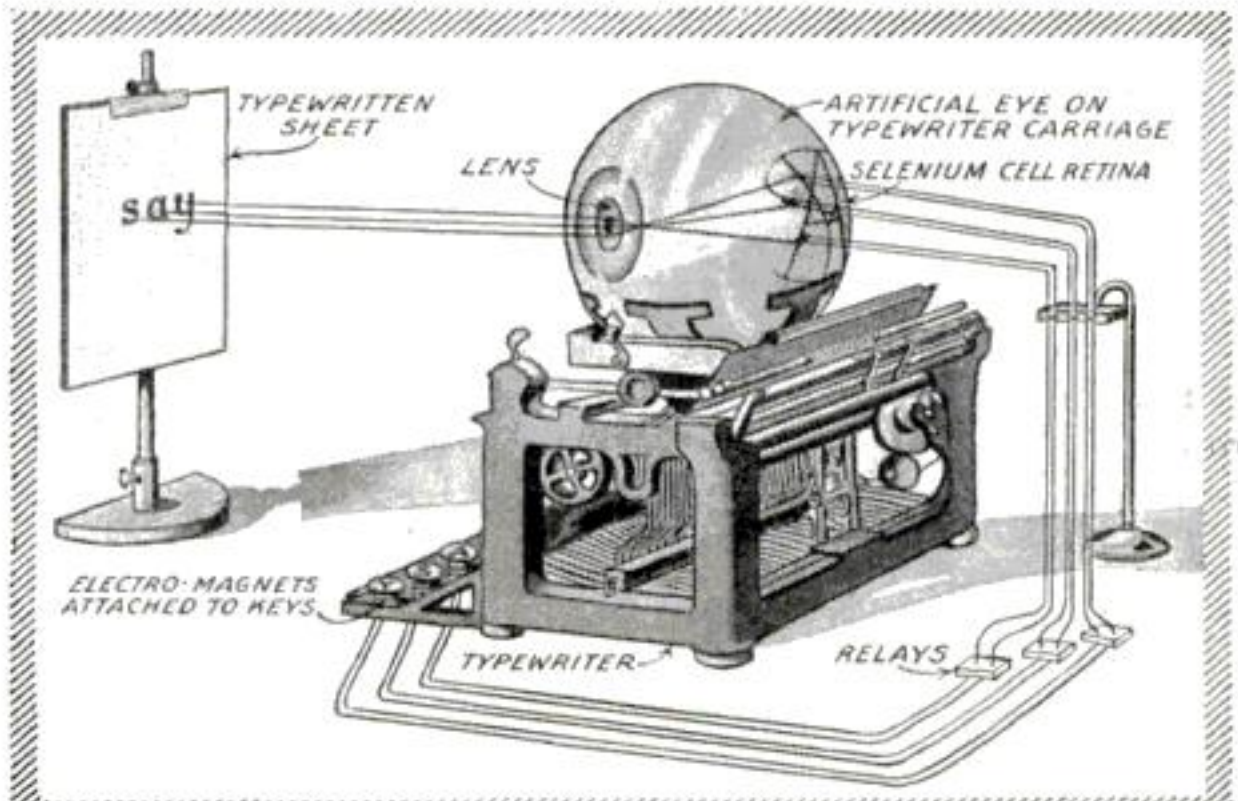
The Copper Kettle Outfit Which Distils the Rhubarb Brandy Drop by Drop

A One-Eyed Machine Stenographer

IN the July number of the POPULAR SCIENCE MONTHLY we described a typewriter operated by the human voice. Mr. John B. Flowers, of Brooklyn, N. Y., the inventor, has devised another machine, which is nothing more or less than an "eye-operated typewriter."

On top of this new machine is a huge round ball. That ball is a mechanical eye—equipped with a lens and a retina just like the human eye. Hold a typewritten sheet of paper up in front of that eye, and it "sees" it, even as all of us would.

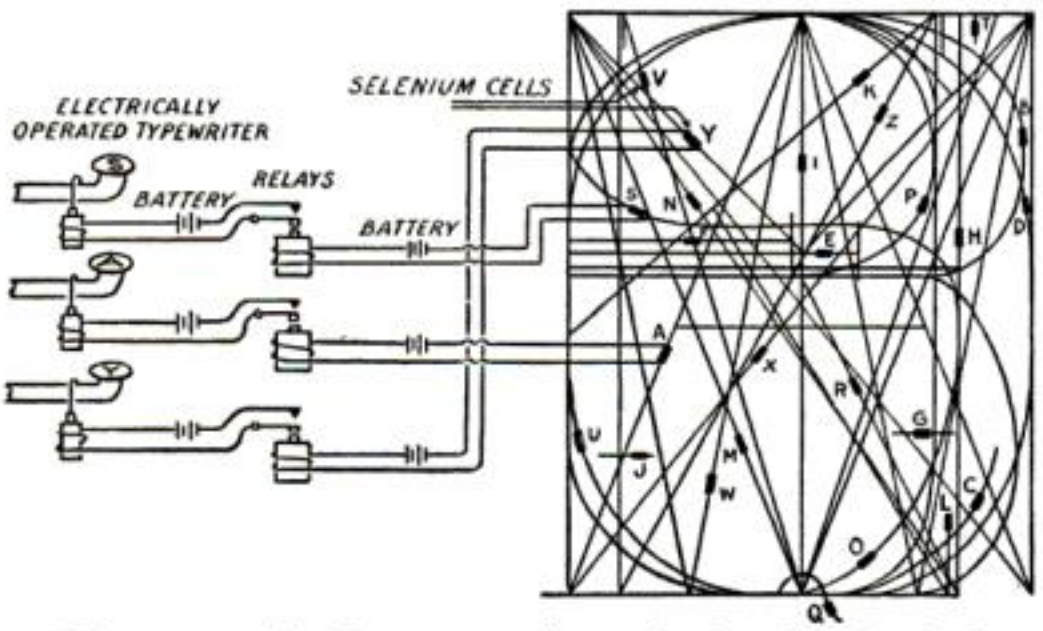
Unfortunately, perhaps, that eye can not turn in a socket like ours, so it rides to and fro on the typewriter carriage instead, the lateral motion of the carriage causing the eye to progress from one word to the next of the line of print which it is mechanically copying.



The Typewriter Operated by the Mechanical Eye. The Huge Round Ball on Top Is the Eye. It Happens at the Moment To Be "Looking" At the Word "say" on the Sheet of Paper at the Left. As the Eye Rides Along on the Typewriter Carriage the Separate Letters of "say" Fall on the Eye's Retina in Succession. Selenium Cells Are So Mounted in This Retina that the "S," "A" and "Y" Each Has a Cell of Its Own, So Placed That the Image from No Other Letter Than the Right One Can Affect It. In This Way the Word "say" Is Copied

When the end of the line is reached and the eye can not see anything but blank paper ahead, like a sensible being it sends an impulse down into the inner workings of the machine to shift the paper ahead one line, and to move the carriage back to the other end of its track to start anew—which both paper and carriage promptly and obediently proceed to do.

The eye depends for its properties upon a number of selenium cells. These are so arranged that each one can be affected only by one letter out of the alphabet. The inventor of this remarkable contrivance has already succeeded in getting it to work satisfactorily on simpler letters. The ordinary business man has probably never thought that the time would come when he would have a one-eyed stenographer in his office, and a mechanical one at that, but apparently that time is not far off, if the invention works out as well as it promises.

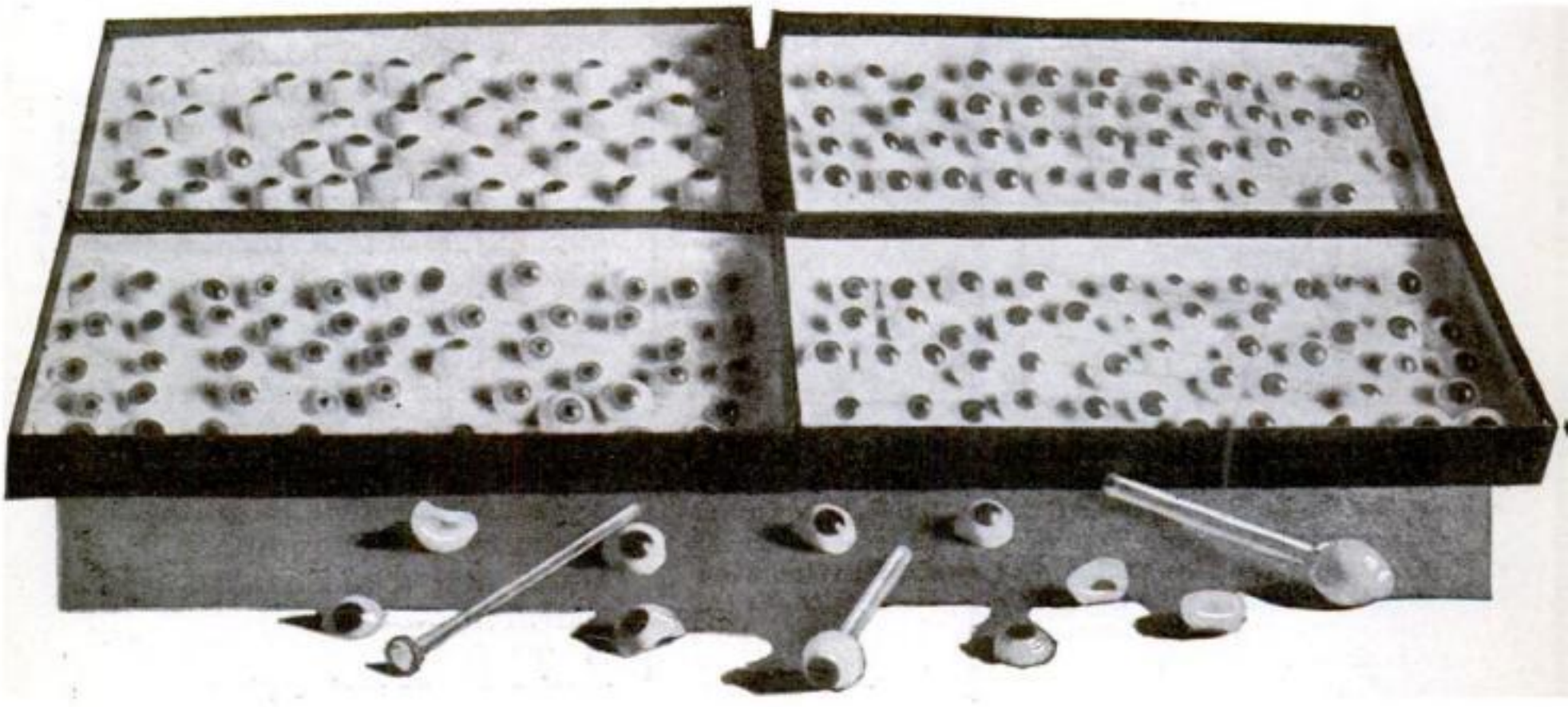


Diagrammatic Representation of the Mechanical Eye-Operated Typewriter. The Complicated Figure at the Right Represents All the Letters of the Alphabet Placed One on Top of the Other. Trace It Through Carefully and Each Separate Letter May Be Picked Out. The Small Black Rectangles Placed One on Each Letter Represent Selenium Cells. This Whole Arrangement Is Placed in the Back of the Mechanical Eye and Is Connected with the Keys

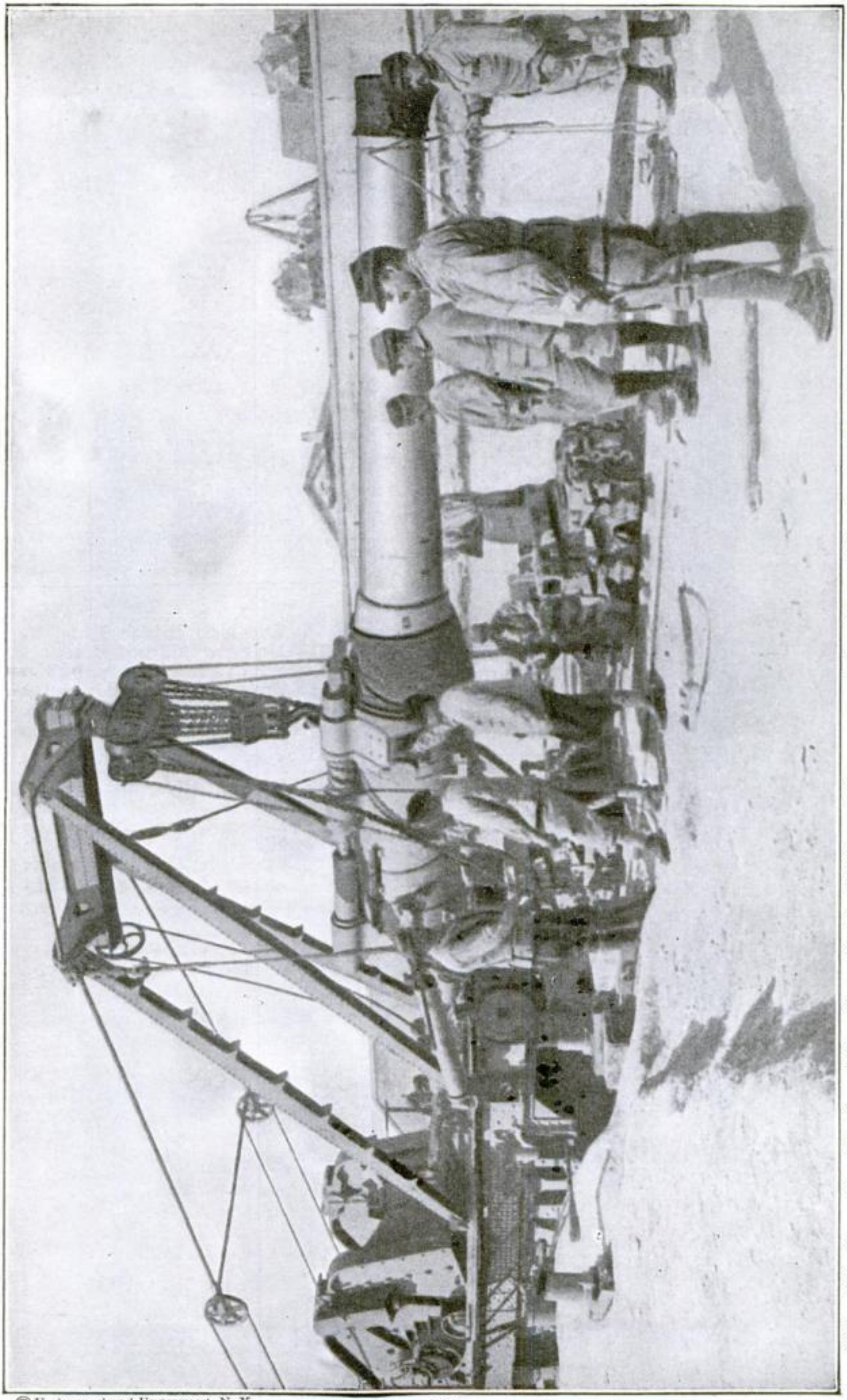
Making Artificial Eyes for Blinded Soldiers

The Artificial Eye Maker First Takes a Tube of Glass, Heats It and Blows It Until a Bubble of Glass Is Formed at the End. The End of the Bubble Is Then Perforated With a Conical Point As Here Shown. Thus the White of the Artificial Eye Is Formed. The Iris, Appropriately Striated, Is Then Fused to This Bubble

Blowing a Bubble of Glass. After the Iris Is Made It Is Soldered to the End of the Sclerotic, or the Imitation White of the Eye Which Encloses the Eye Ball. The Whole Is Then Tinted in Exact Similitude to the Natural Eye

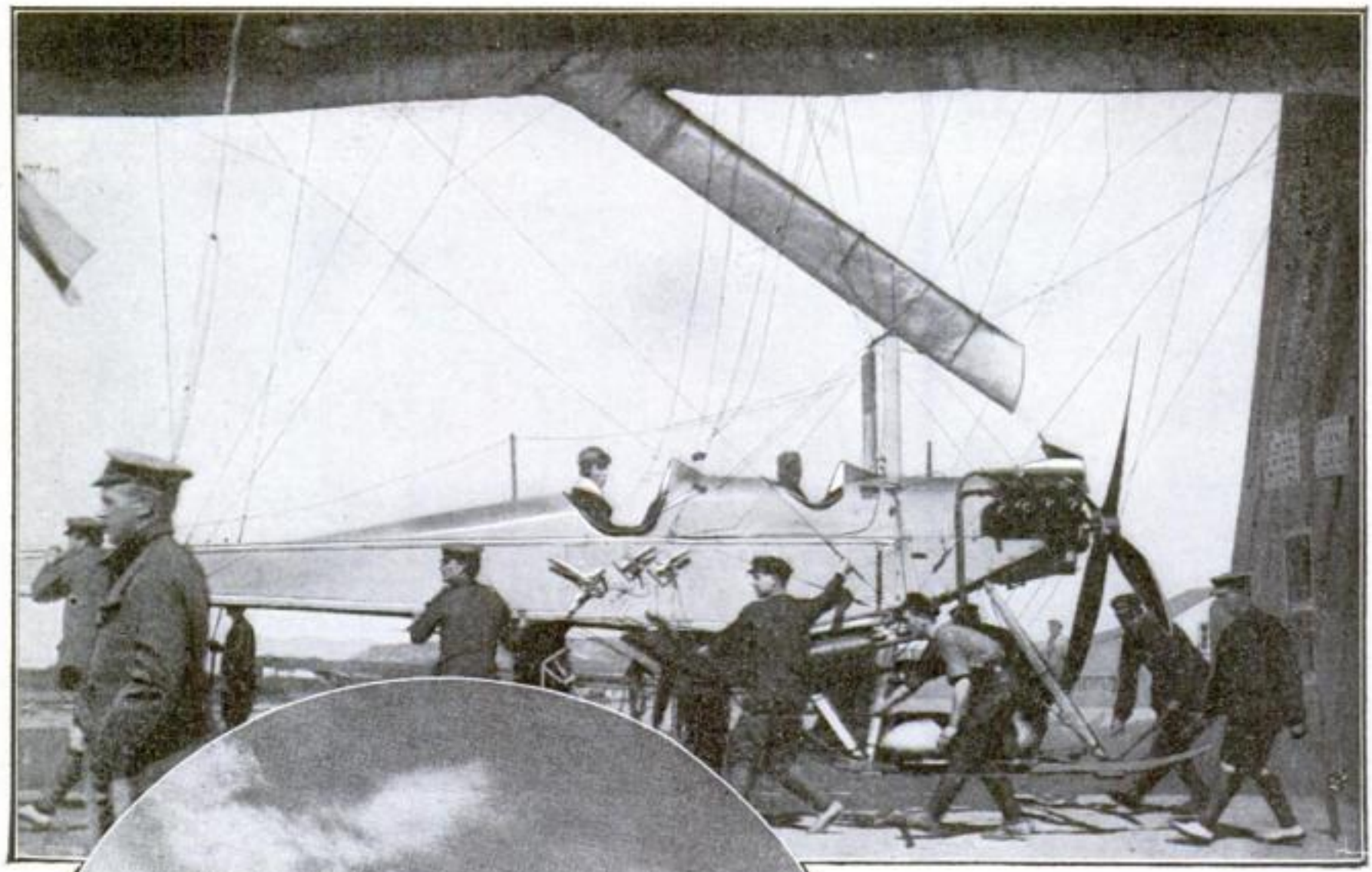


A Twelve-Inch Gun of French Make



When Big Guns Are Mentioned One Immediately Thinks of Germany and the Havoc Wrought by Her "Big Berthas" and Her 42-Centimeter Howitzers. France, However, Has Come to the Forefront with Big Guns of Her Own Which Have Played an Important Part in Her Defensive Warfare. The Illustration Shows a 12-Inch French Gun Being Hoisted Into Position for Dealing Destruction in the Great War Game

Britain's New Idea in Dirigibles



The New British Dirigible. Note the Stiffened Hose, Up Which Air Is Forced by the Tractor Screw, Distending the Gasbag and Keeping It Inflated in a Cigar Shape

At Left, the Same Dirigible Silhouetted Against the Sky

Below, Suspended Under the Well-Shaped Gasbag with Stabilizing Fins and Rudders Is an Aeroplane Fuselage

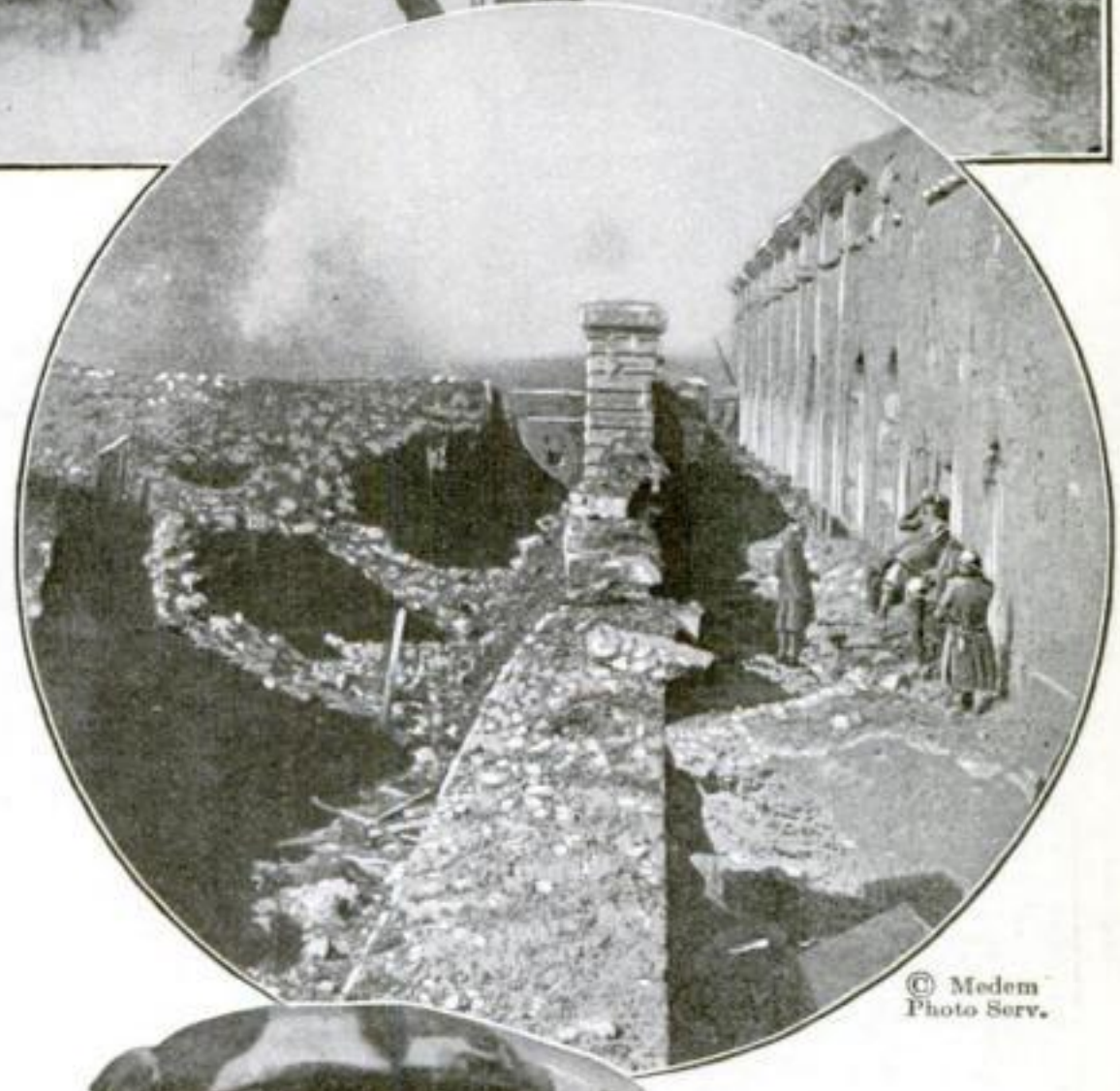
Big Guns and the Havoc They Wreak

© Int. Film Serv.

A Heavy Howitzer Being Fired in France. These Men Are Firing at an Enemy They Never Have Opportunity to See. They Are Merely Automatons in the Game of War

At Right: Fort Vaux Under Actual Bombardment. Shells Are Exploding in Front of the Soldiers in the Picture. All Retreat Was Cut Off and These Men Later Surrendered

Below: Big Artillery Pieces Being Hauled to the Verdun Front by Tractors. The Heaviest Artillery Fire of This and Any Other War Has Taken Place at Verdun



© Medem Photo Serv.

© Underwood and Underwood, N. Y.

Interesting Snap-Shots from Verdun

© Int. Film Serv.

A Storing Place for War Material Behind the French Front. As This Material Is Needed by the Men in the Trenches It Is Forwarded to Them by a Light Railway

© Press Illus. Co.

At Left, German Soldiers Measuring the Distance or Obtaining the Range Before Firing Upon Hostile Aircraft. In Such an Apparatus the Aeroplane and Dirigible Find Their Most Dangerous Enemy

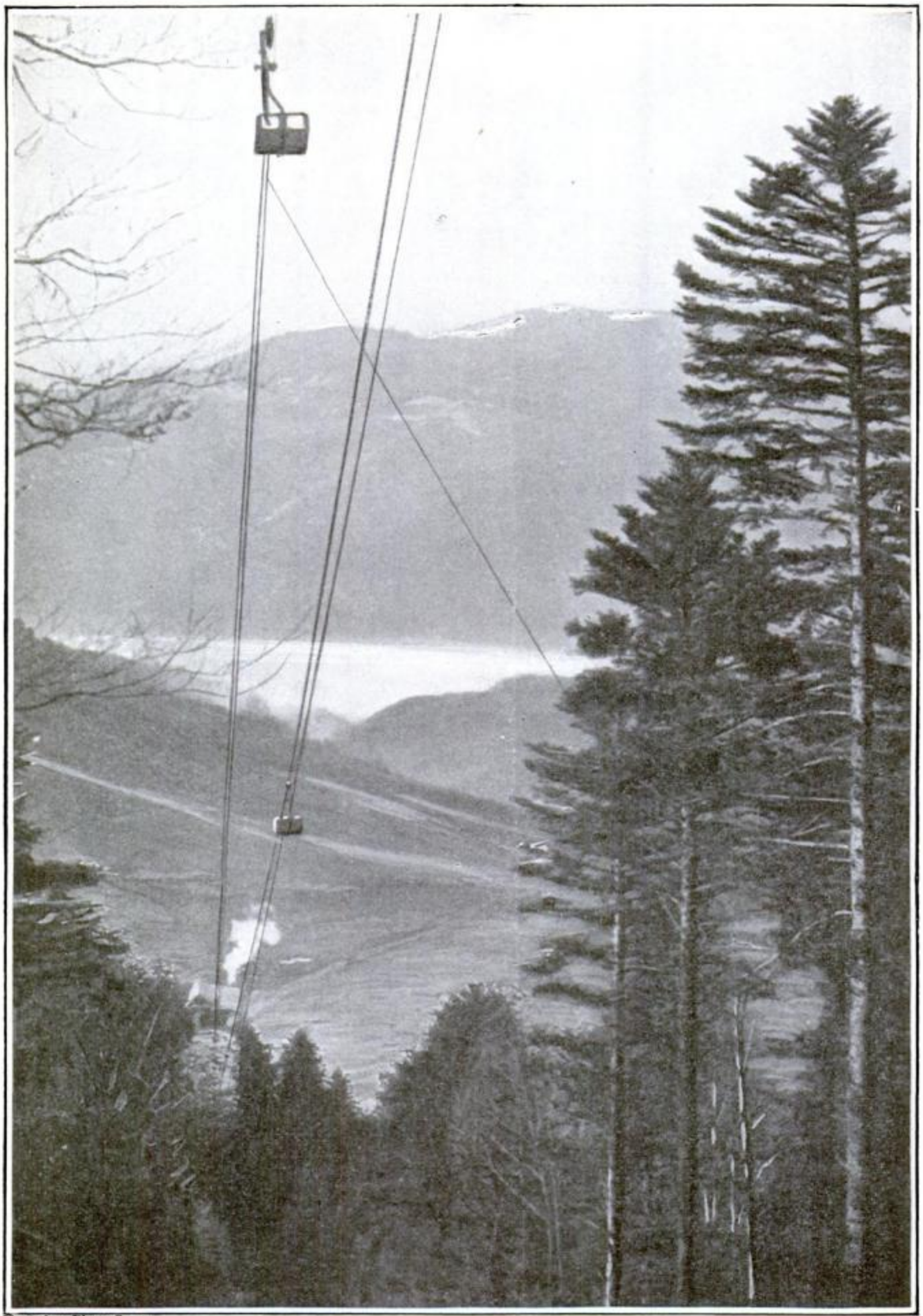
Below, a Temporary Shelter on Wheels Constructed by the German Troops for the Convenience of Their Officers. Needless to Say the Officers Have Had Enough Engagements at the Trenches to Keep Them Occupied and Are Entitled to Their Rest

© Underwood and Underwood, N. Y.

Sengalese Troops Distributing Rifles to the Recently Arrived Russian Troops at Marseilles. Russia Has Now Added Many Seasoned Thousands to the French and English Forces Entrenched Along the Western Front. The Scarcity of Ammunition Is No Longer a Drawback

A Giant Buoy Which Ran Ashore on the Belgian Coast. It Was Used to Support Part of the Wire Netting Barrier Strung Across the English Channel to Entangle Submarines

Sending Ammunition to the Mountain Tops



© Medem Photo Serv.

Carrying Ammunition to the Top of the Vosges Mountains by a Cableway Especially Constructed for the Purpose. At This Point the Mountain Is Roadless and the Cable Was an Absolute Necessity. Such Cableways Have Long Been Used by Mining Engineers

Nursing the Wounded Chargers

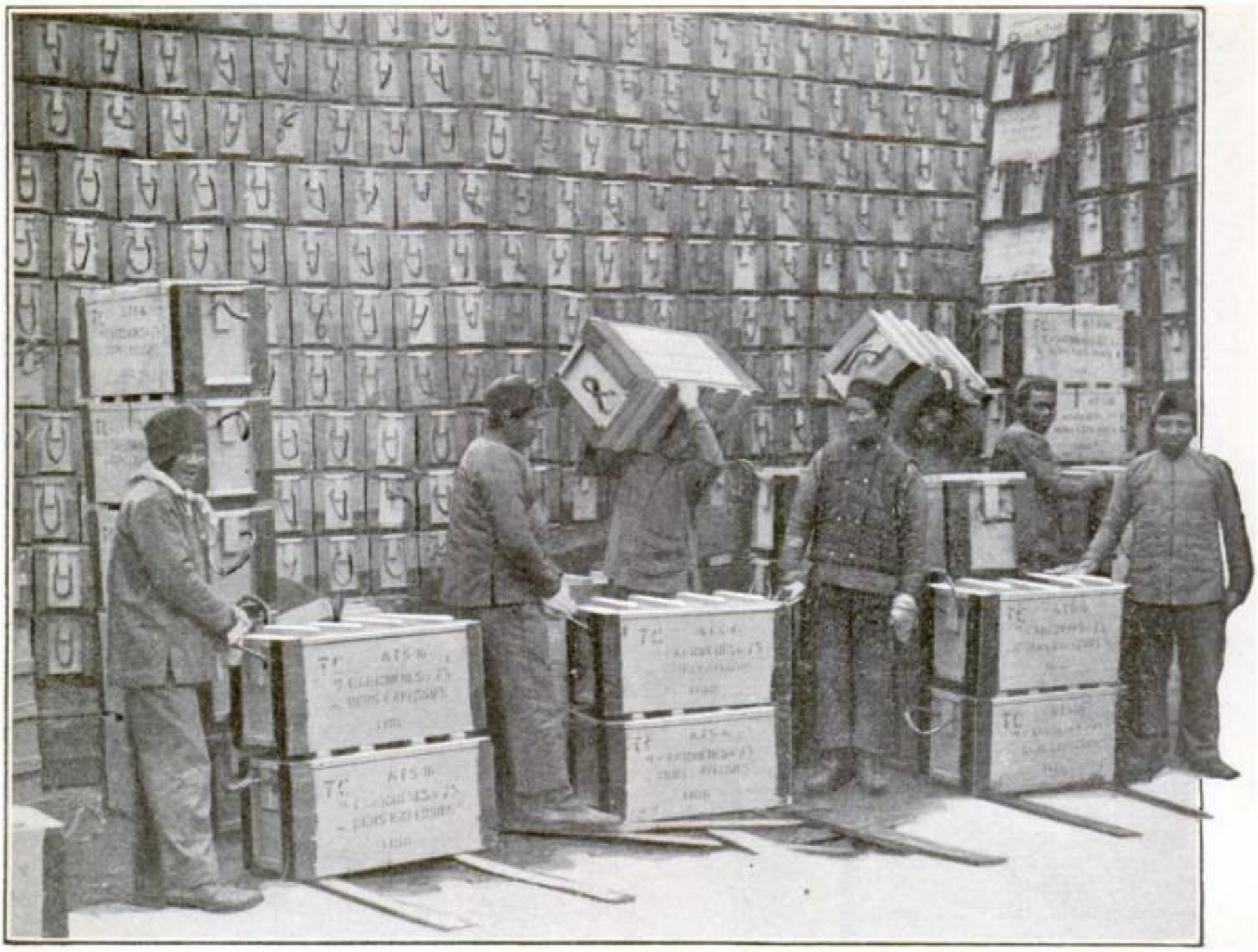
A British Veterinary Traveling Hospital in France Which, Though Small, Is Fully Equipped. There Is a Special Staff Whose Sole Duty Is to Attend to the Ills of the Animals

Photos © Int. Film Serv.

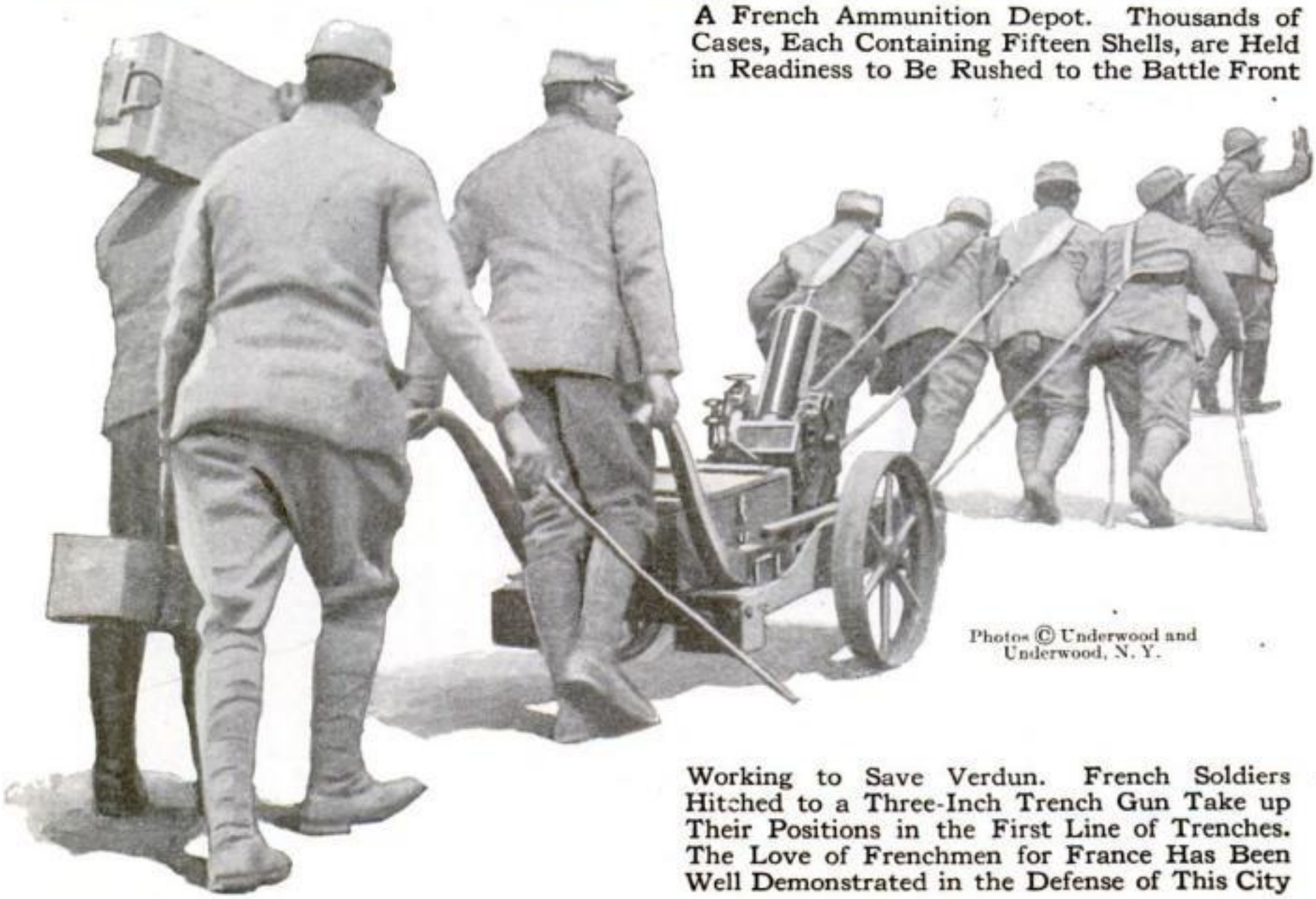
The Horse at the Right Has Contracted a Skin Disease. It Has Just Emerged from a Warm Disinfecting Bath and Is Being Diligently Scrubbed with Long-Handled Brushes

Below: the Veterinary Hospital Staff Performing an Operation on a Patient Under Chloroform. In This Picture the Operating Table Is Mother Earth and the Operating Room All Outdoors

Shells and Guns for Verdun



A French Ammunition Depot. Thousands of Cases, Each Containing Fifteen Shells, are Held in Readiness to Be Rushed to the Battle Front



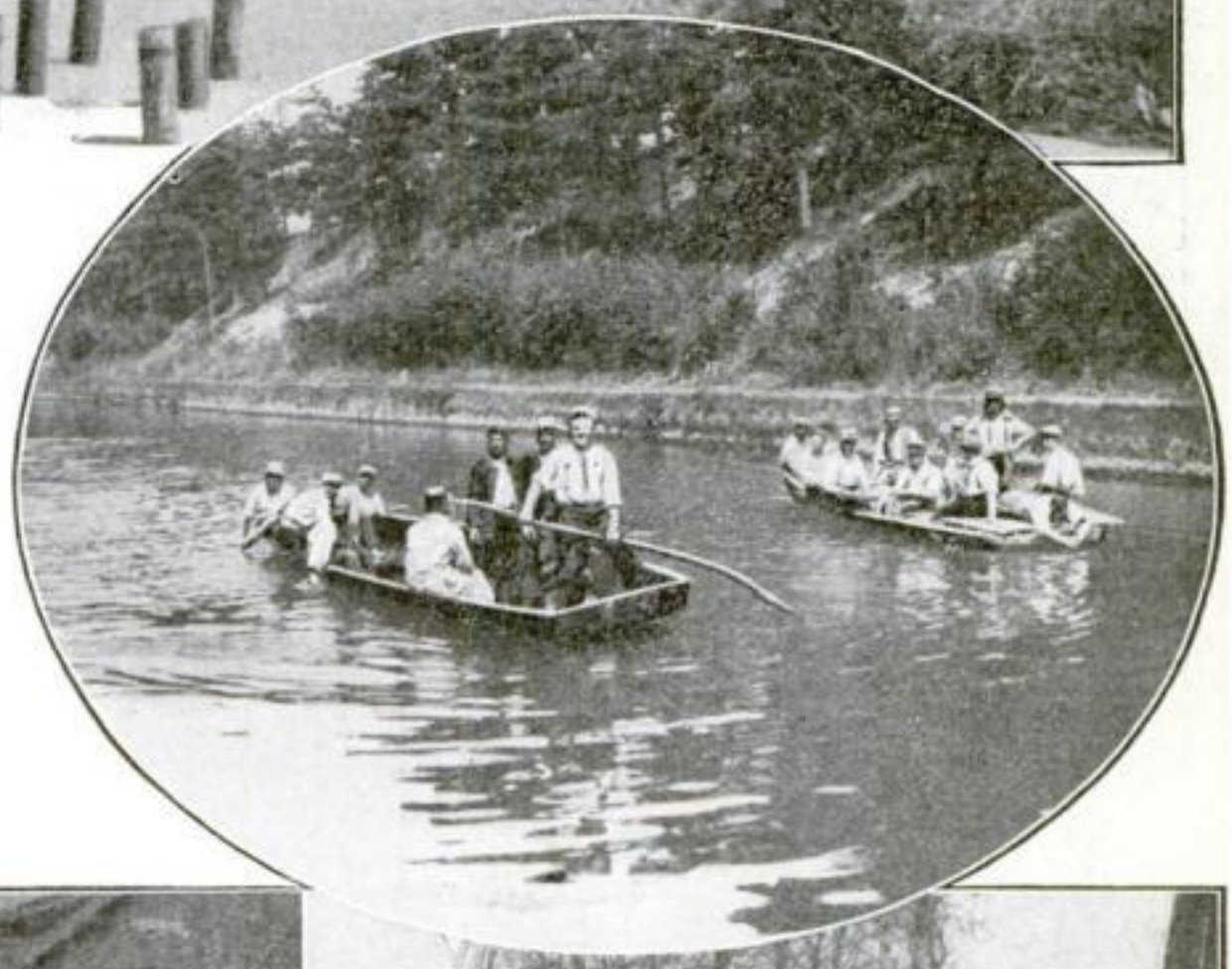
Photos © Underwood and Underwood, N. Y.

Working to Save Verdun. French Soldiers Hitched to a Three-Inch Trench Gun Take up Their Positions in the First Line of Trenches. The Love of Frenchmen for France Has Been Well Demonstrated in the Defense of This City

Even War Has Its Sports

A Game of Nine-Pins Behind the Fighting Lines. Empty Shells Take the Place of Wooden Pins but the Photographer Does Not Say Whether the Ball Is a Cannon Shot or Not

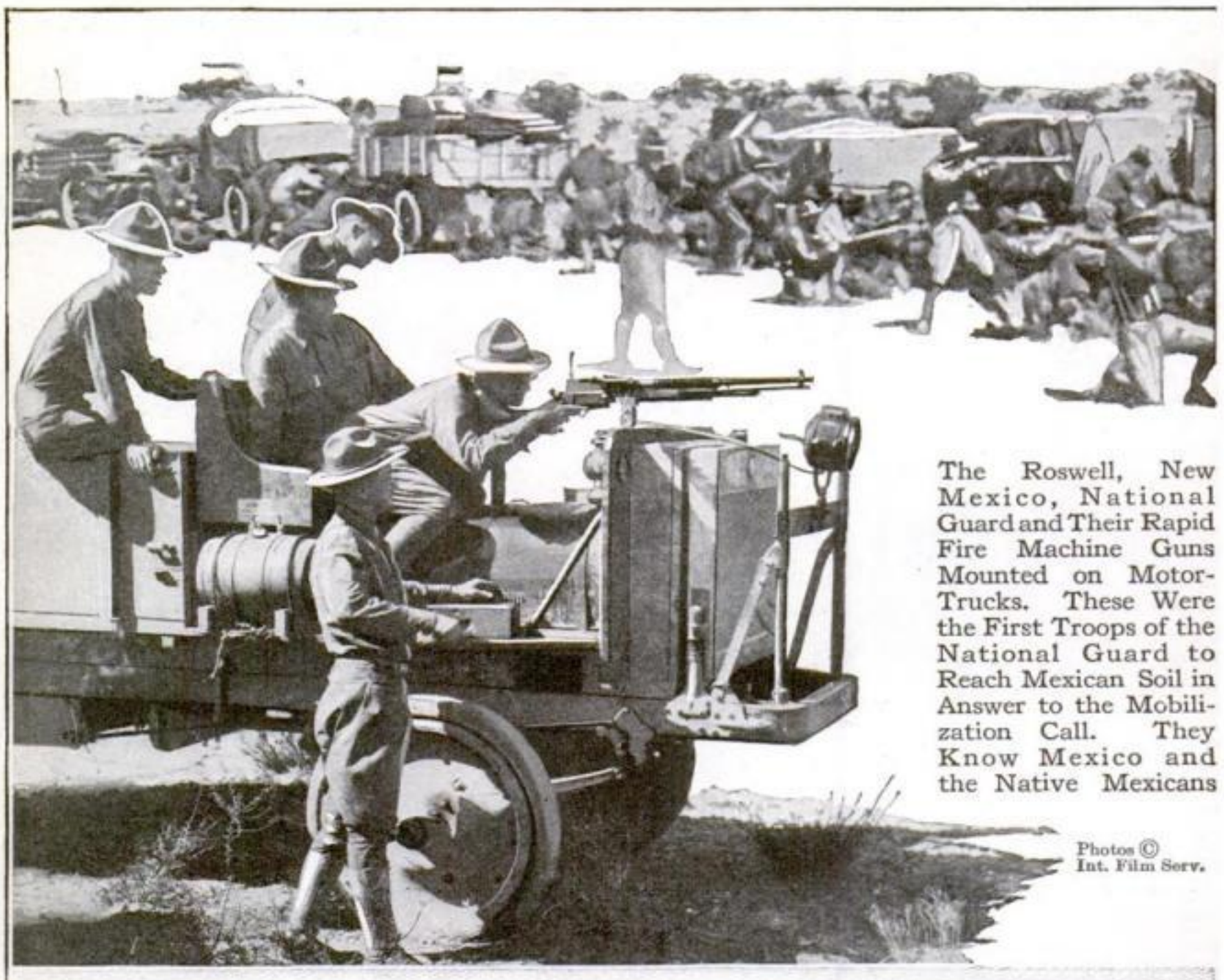
At Right: A Sail Down a River That the Censor Does Not Care to Mention. The Boats Are Improvised Rafts and Where the Usual Paddles Are Not Provided Human Hands Take Their Place



Ferrying Across a Flood Stream with What Was Once a Good Washing Tub

A Few Hours Peaceful Angling for Fish Beyond the Smell of Exploding Powder

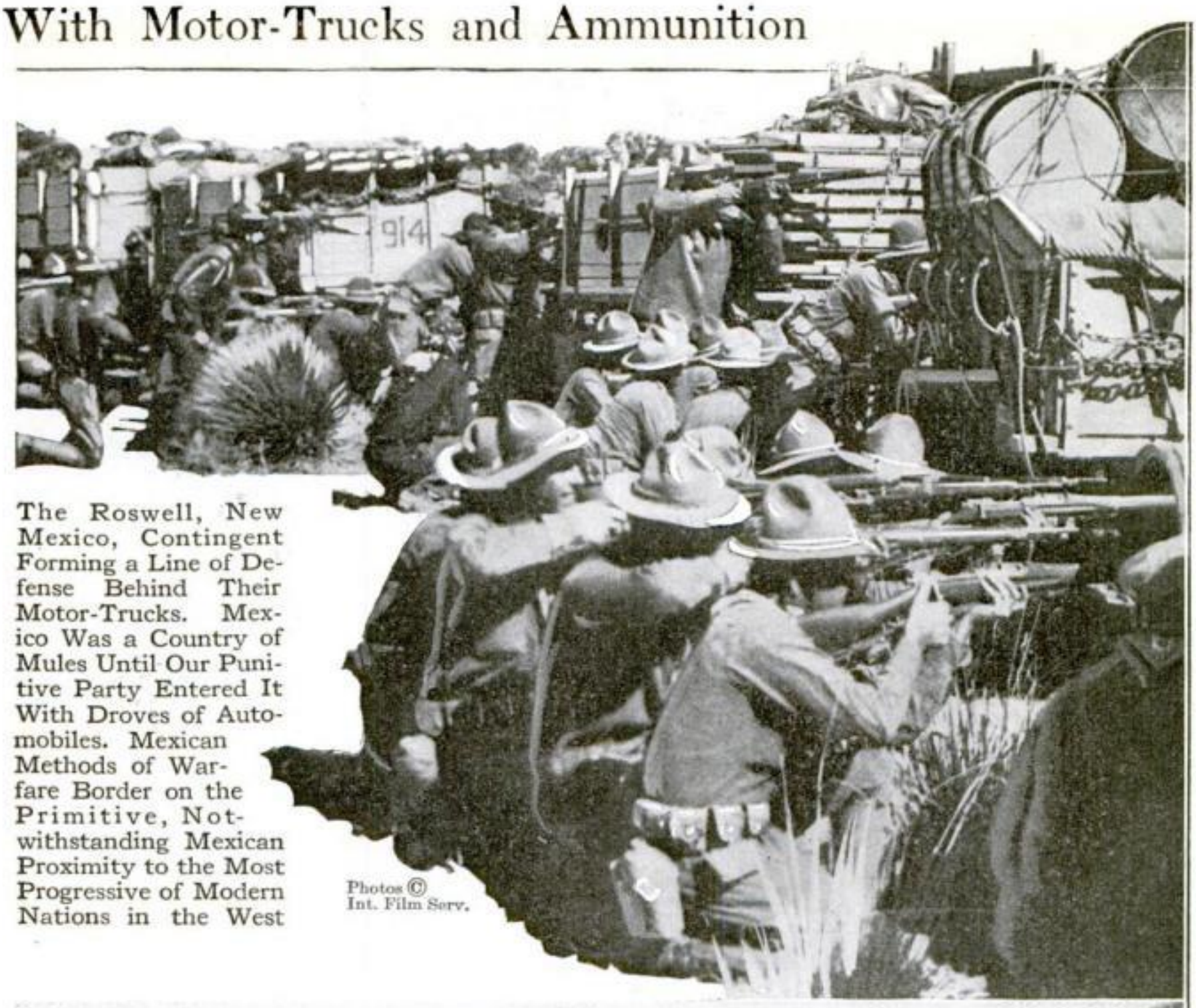
Introducing Law and Order Into Mexico



The Roswell, New Mexico, National Guard and Their Rapid Fire Machine Guns Mounted on Motor-Trucks. These Were the First Troops of the National Guard to Reach Mexican Soil in Answer to the Mobilization Call. They Know Mexico and the Native Mexicans

A Detachment of Our Troops Entering the Wastes of Mexico, the Country That God Made Last, as One Trooper, Who Was Probably Homesick, Described It in a Letter Home

With Motor-Trucks and Ammunition

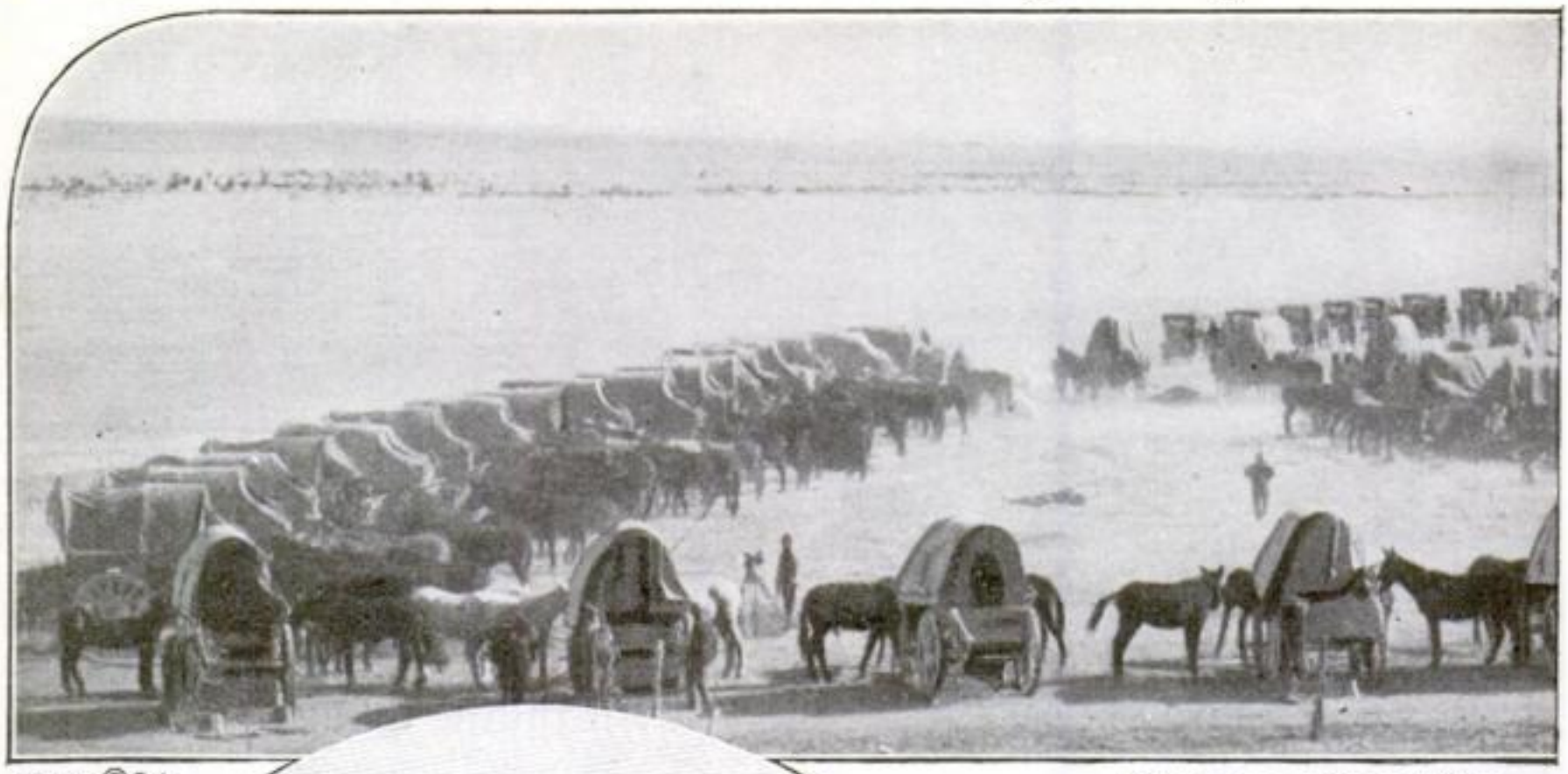


The Roswell, New Mexico, Contingent Forming a Line of Defense Behind Their Motor-Trucks. Mexico Was a Country of Mules Until Our Punitive Party Entered It With Droves of Automobiles. Mexican Methods of Warfare Border on the Primitive, Notwithstanding Mexican Proximity to the Most Progressive of Modern Nations in the West

Photos © Int. Film Serv.

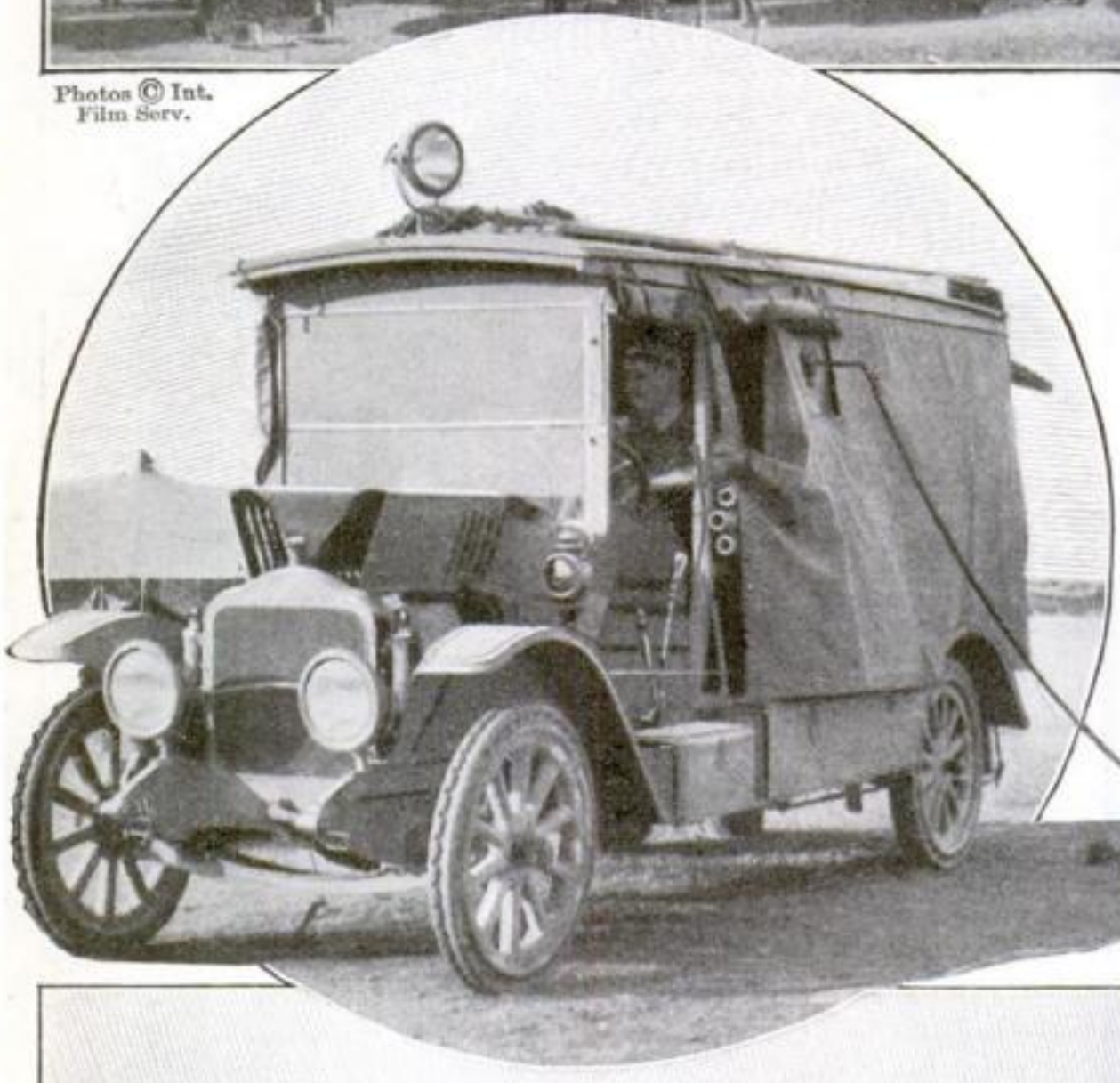
Great Stretches of Barren Land with Sage Brush and Sand, a Merciless Sun and a Thirst That Is Never Satiated—That Is What Our Troopers Will Remember About Mexico

Our Standing Army's Enforced



Photos © Int. Film Serv.

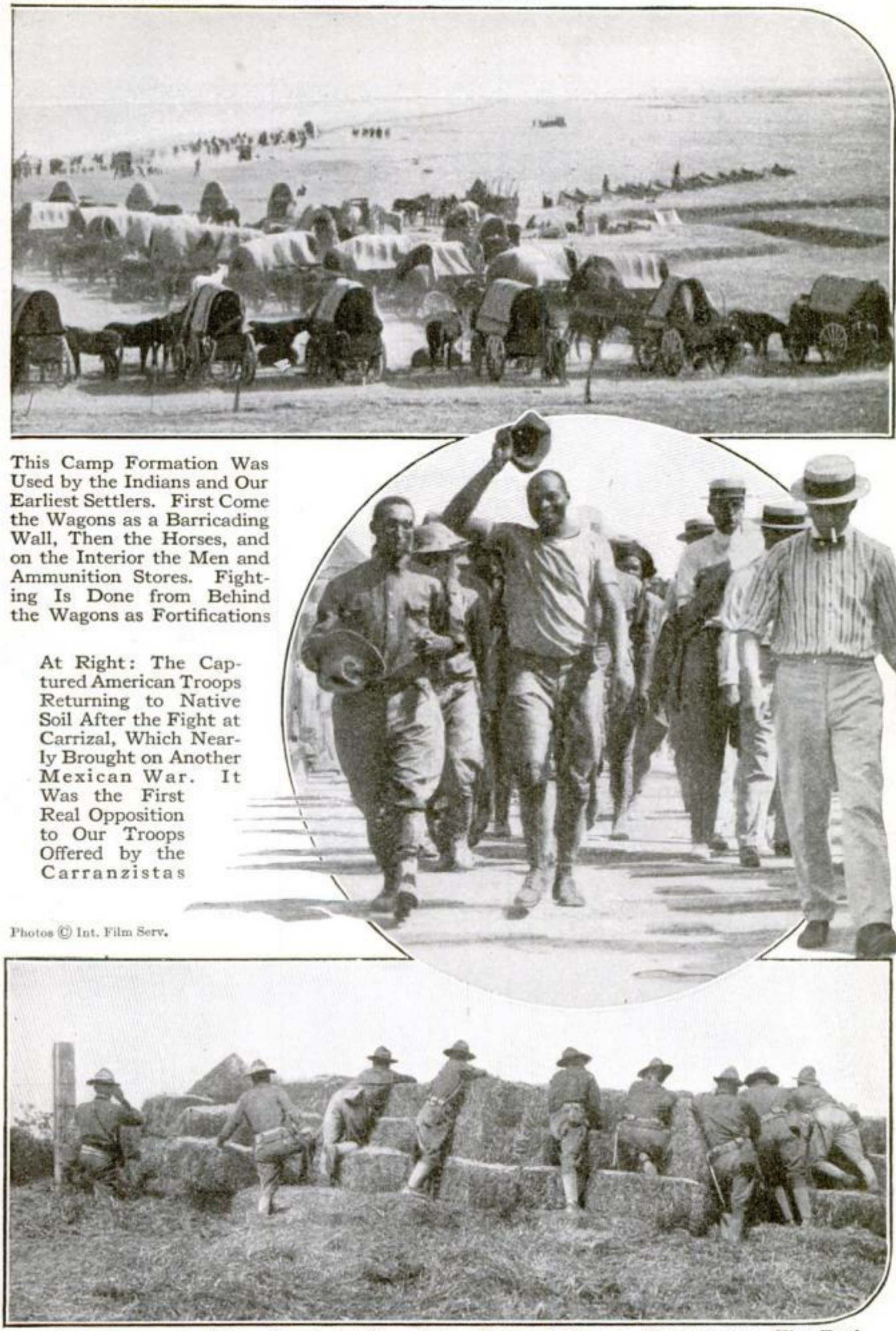
A Temporary Camp Made on Villa's Trail, Long Since Grown Cold. Note the Hardly Discernible Long Line of Automobiles Bringing Up the Rear of an Advancing Column. The Horses Require Frequent Rests in the Desert



At left, A Modern Wireless Station on Wheels Is Stationed at Namiquipa. From This Station Has Come Most of the News Concerning the Advance of Our Men Who Are Now Several Hundred Miles in the Interior

Enjoying the Most Valuable Thing in All Mexico—a Bath. Such a Luxury Is About as Rare as Lobster Salad with Tomatoes and Lettuce as a Side-dish in the Army Rations

Two-Months' Vacation In Mexico



This Camp Formation Was Used by the Indians and Our Earliest Settlers. First Come the Wagons as a Barricading Wall, Then the Horses, and on the Interior the Men and Ammunition Stores. Fighting Is Done from Behind the Wagons as Fortifications

At Right: The Captured American Troops Returning to Native Soil After the Fight at Carrizal, Which Nearly Brought on Another Mexican War. It Was the First Real Opposition to Our Troops Offered by the Carranzistas

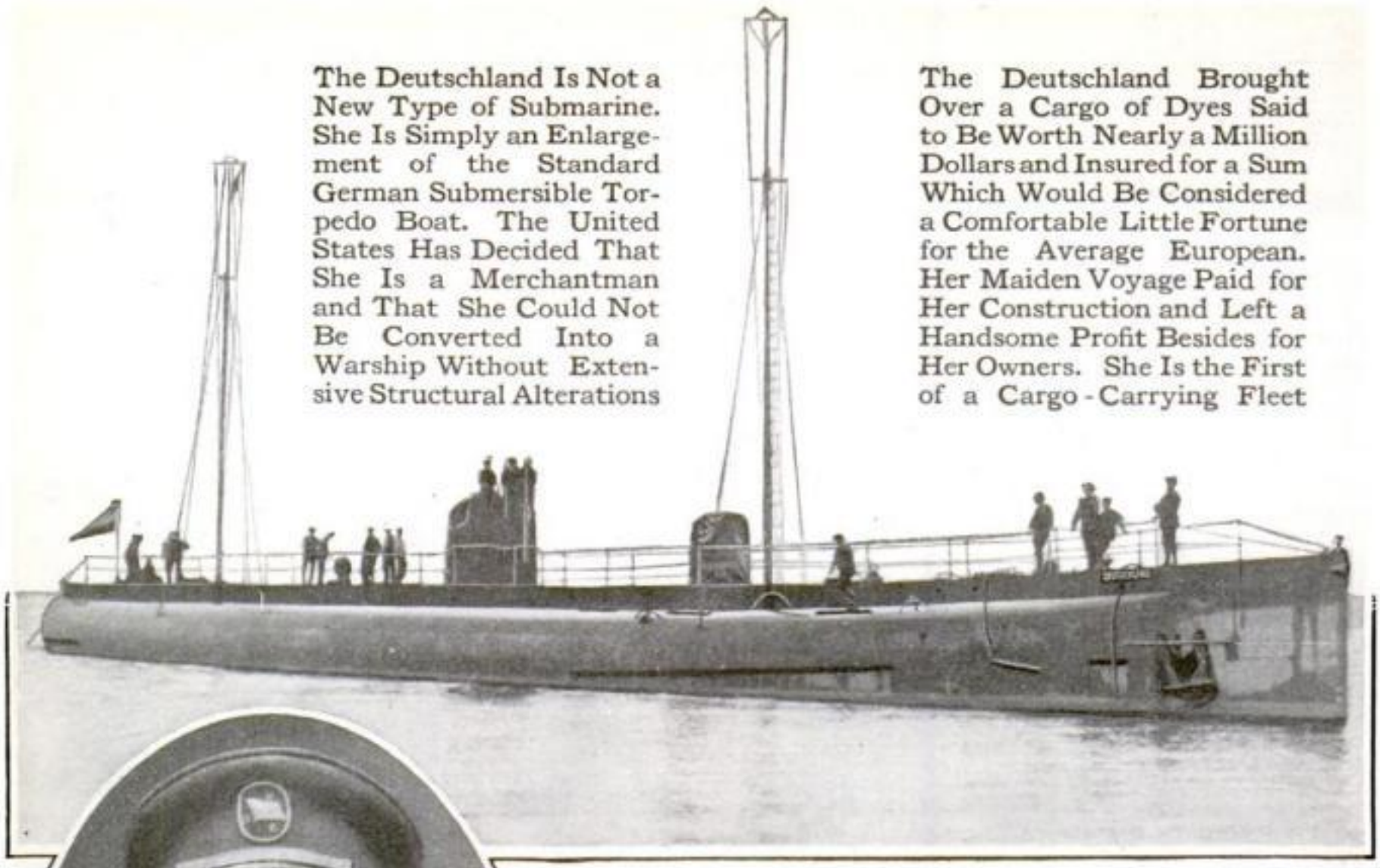
Photos © Int. Film Serv.

A Detachment of Our Coast Artillery Using Bales of Hay as Breastworks. The Real Fighting So Far Has Been Done in the Open Without Protection of Any Kind

Bringing Dye Stuffs to America from Germany

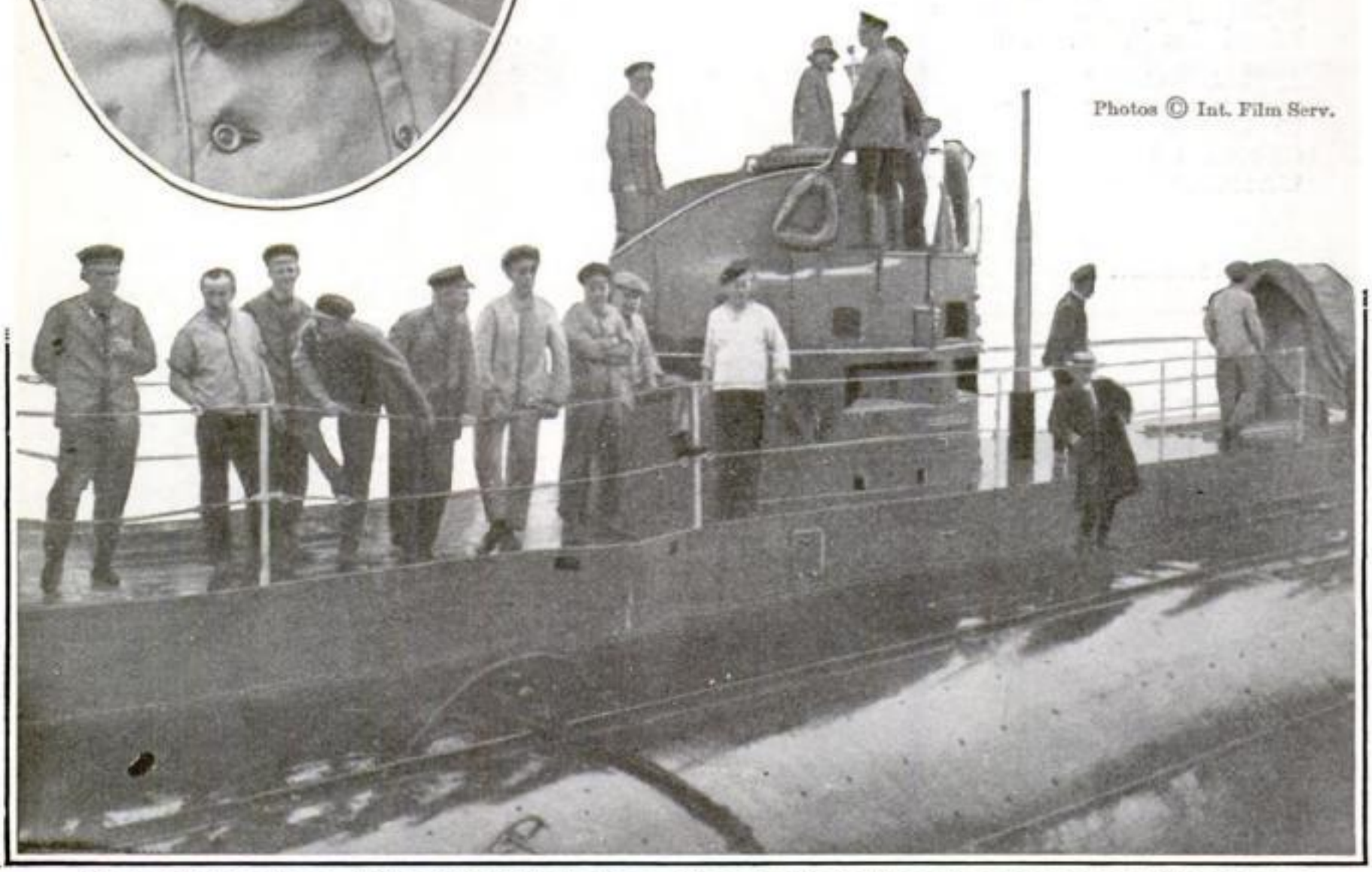
The Deutschland Is Not a New Type of Submarine. She Is Simply an Enlargement of the Standard German Submersible Torpedo Boat. The United States Has Decided That She Is a Merchantman and That She Could Not Be Converted Into a Warship Without Extensive Structural Alterations

The Deutschland Brought Over a Cargo of Dyes Said to Be Worth Nearly a Million Dollars and Insured for a Sum Which Would Be Considered a Comfortable Little Fortune for the Average European. Her Maiden Voyage Paid for Her Construction and Left a Handsome Profit Besides for Her Owners. She Is the First of a Cargo-Carrying Fleet



To the Left, Captain Koenig Who Goes Down in History as the Commander of the First Cargo-Carrying Submarine to Make the Trip Across the Ocean

Below, the "Bridge" and Conning Tower of the Deutschland. The Construction Is Entirely of Steel, Not One Inch Being Conceded to Decoration



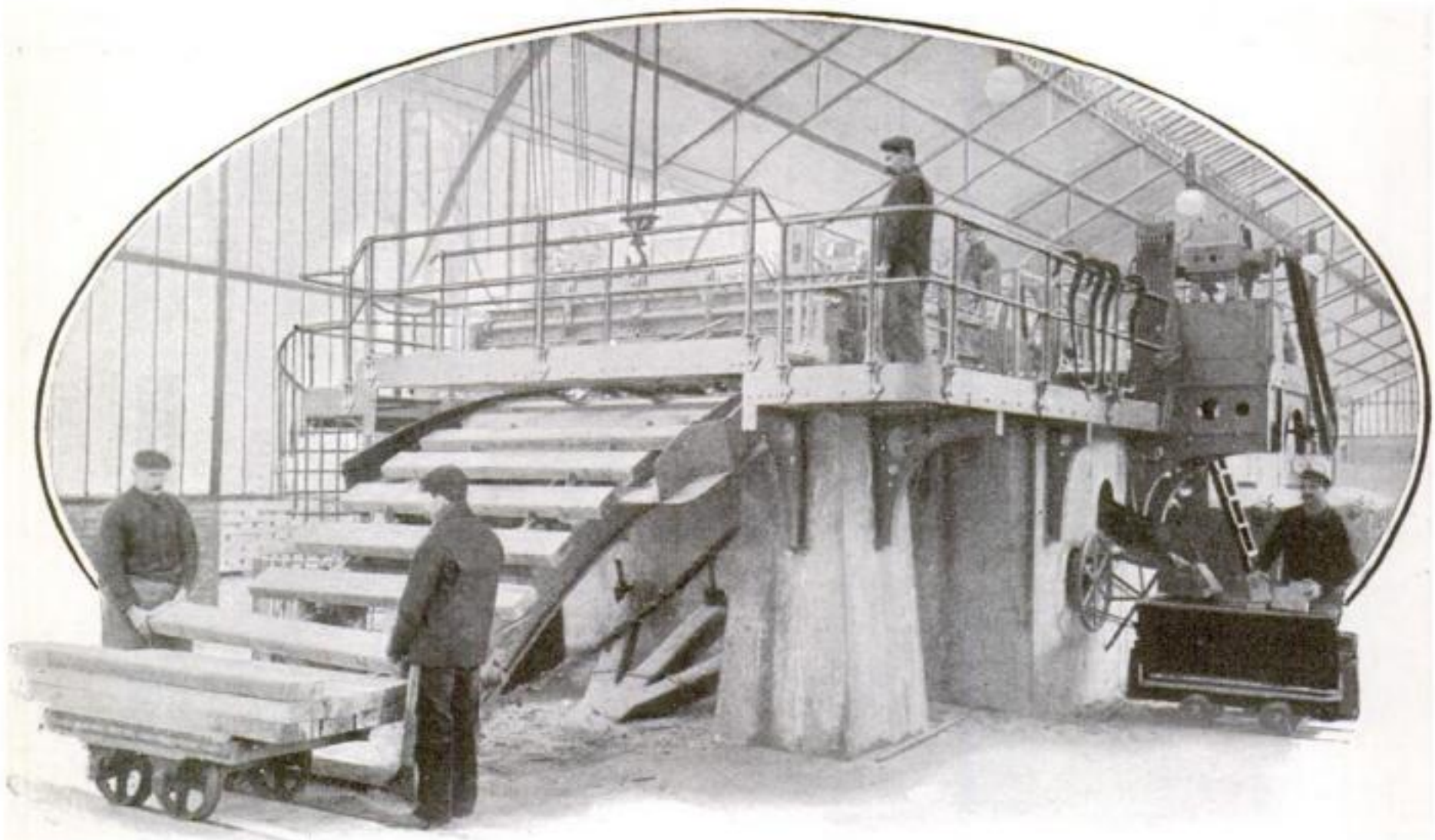
Part of the Crew. They Do Not Look as Though Their Recent Achievement Counts for Much in Their Estimation Since It Carried Them Out of the Excitement of the War Zone

Via the Famous Submarine "Deutschland"

© Int. Film Serv.

Looking More Like the Familiar Whale-Back Than Anything Else, the "Deutschland" Made Her Way into Baltimore to the Astonishment of the Entire World. She Is Three Hundred Feet Long and Therefore Smaller Than the Enormous Craft Which Rumor Had Taught Us To Expect

The Paving Blocks of Paris



An Important Part of the Machine Is a Conveyor Which Supplies the Timbers

LIKE many another modern city Paris is paved in part with wooden blocks. The municipal workshop has to supply twenty-five million blocks a year. A large amount of blocks must be kept in stock because the supply of wood is not constant.

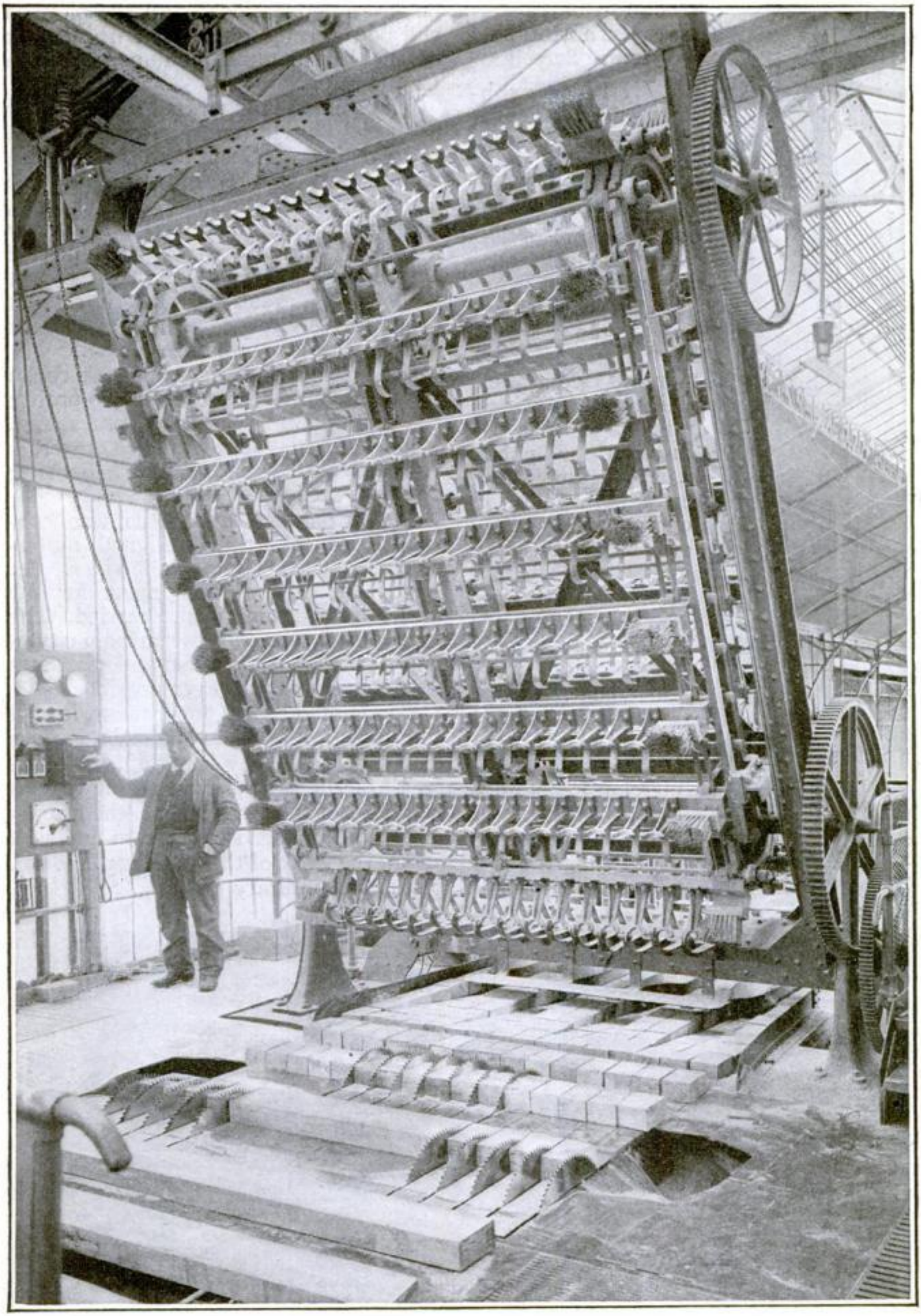
It was consequently necessary to construct a machine that could turn out the desired amount of paving a year while subject to these interruptions of supply. This was done by a M. Josse who produced a wood cross-cutting machine with seventeen circular blades that can make two hundred and forty thousand wooden paving-blocks in a day of ten hours. It economizes both wood and labor. Twenty workmen can run it.

The important part of the machine is a conveyor which is held in a frame which can be swung up or down. Two endless belts carry a series of fingers. These are mounted on bars which run from belt to belt, and there are sixteen fingers to each cross-bar. The fingers catch each beam as it comes up to the table and feed it to the saws. The saws are not arranged in just a single row, but in several rows. One row cuts the center of the beam only; the other rows, the sides. The wood is brought by trucks to the foot of the machine where two workmen place the beams on the chain of the conveyor.

The cross-bars carrying the fingers are provided each with two little brooms to sweep off the chips and sawdust.

The saws, seventeen in number, are circular blades twenty-six inches in diameter. They are divided into three groups so as to avoid the vibrations which would result from using only one shaft of a diameter in proportion to that of the blades running at the high speed of two thousand revolutions a minute.

The first two sets of saws trim off the exterior edge of the wood and cut four blocks each; then the following set of seven saws cuts the central section of the beam into blocks. After this the blocks, drawn along continually by the fingers, pass under rollers, eventually to be pushed out by the following series of blocks. The blocks slide down a chute upon tables from which workmen take them and throw them onto small cars.



The Conveyor Raised from the Sawing Table. Two Endless Belts Carry a Series of Fingers Mounted on Bars Running from Belt to Belt. These Grasp and Propel the Blocks

Washington Monument as a Motion-Picture Screen

WHAT is probably the largest motion-picture screen in captivity is claimed by the city of Washington, D. C. It is nothing more or less than the Washington monument and it has been pressed into service by the resourceful Bureau of Commercial Economics, which has decided that as long as the out-of-door public must have its cinema entertainment, it can get along without Mary Pickford and Charles Chaplin for the time being and subject itself to an educational and uplift movement.

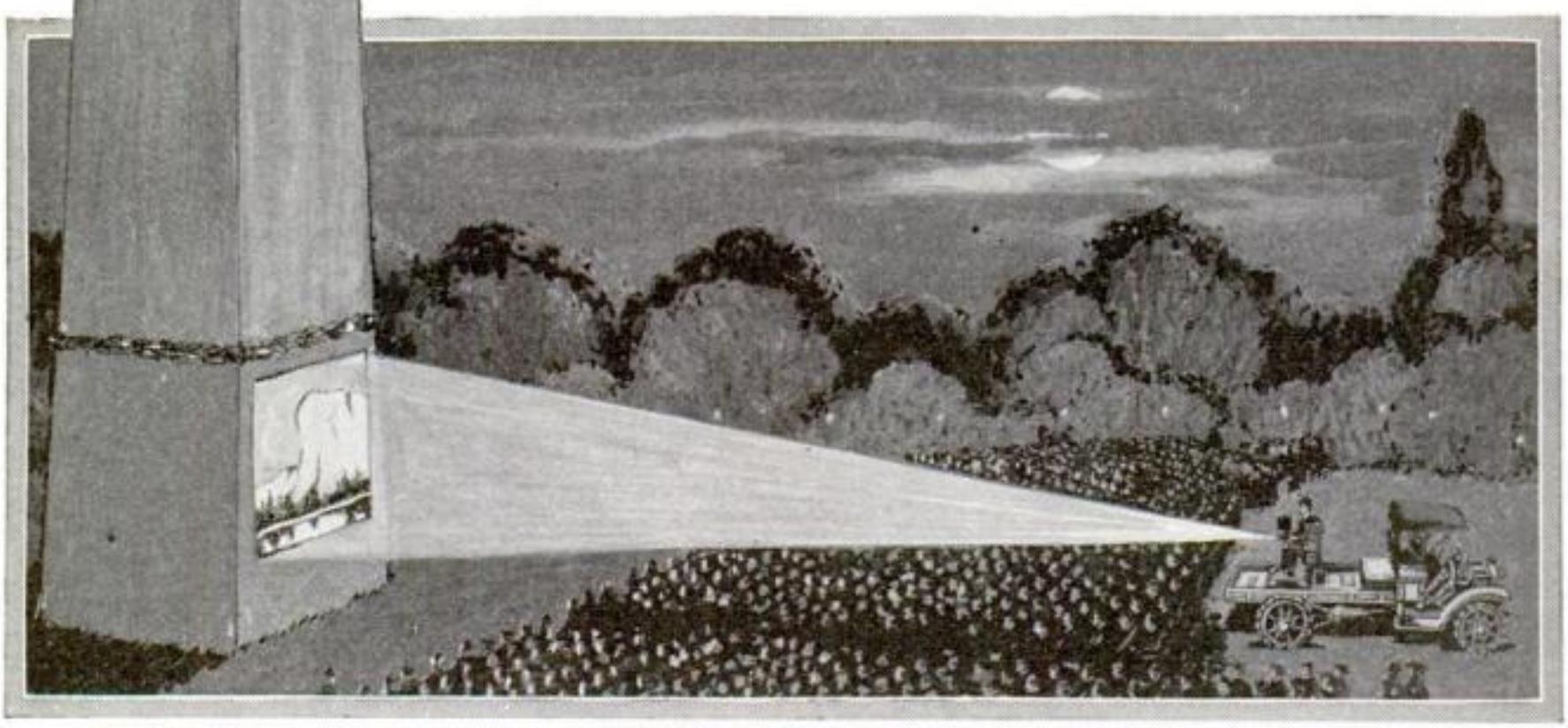
It is the avowed purpose of the Bureau of Commercial Economics every once in a while to conduct motion-picture shows which are to be strictly educational, and the pictures will be projected on the fair white sides of the Washington monument in the Capitol city.

The Bureau inaugurated its season by a special "invitation performance" on the evening of Decoration Day, when scenes from the Grand Canyon, the Yellowstone, the Yosemite, Crater Lake, Mount Rainier, Sequoia, and other nationally famous places were flashed against the towering shaft. A cold, wet night kept a great many away, so that comparatively few saw the monument's debut as a motion-picture screen.

On account of the monument's rough surface it was found necessary to project the pictures on a special silken screen, which a local florist provided, together with a gigantic wreath having a diameter of thirty-six feet.

The projecting apparatus was contained in a specially-designed motor-truck fitted with removable sides. An electric generating equipment for the projection arc lamp is also carried. The motor-truck was built to run from city to city throughout the east and give free demonstrations wherever possible.

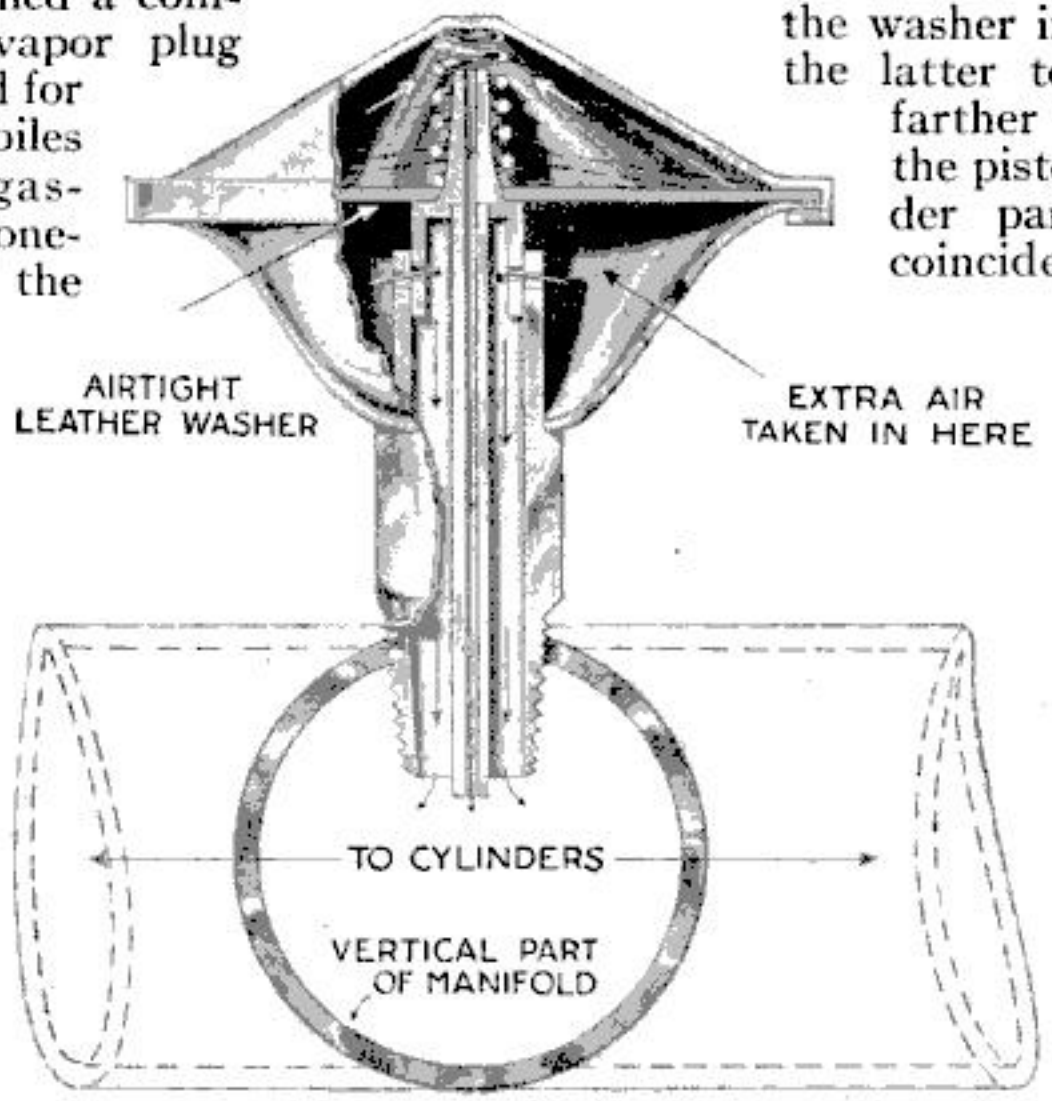
The United States government loaned the films, which were made in various departments. They include, aside from scenic pictures, films showing the various activities of the government, the growth of plants from seed to blossom and seed again, the work of the forest service, and pictures of military training.



The Washington Monument as a Motion-Picture Screen. The Projecting Apparatus Is Contained in a Specially-Designed Motor-Truck Which Is to Run from City to City

Economizing Gasoline for Automobiles

A DEVICE called a compensating vapor plug has been designed for use on automobiles to economize gasoline. The two cone-shaped halves of the plug are divided by means of a leather washer around its circumference. At its center this washer carries a small hollow piston, the upper of which extends through the washer. A small pipe-nipple, screwed into the interior of the piston, extends down to the bottom of the plug portion of the device which is in turn screwed into the intake-manifold. This pipe forms a clear passage between the manifold and the half of the device above the air-tight washer. The small piston is provided on opposite sides with two slots opposite similar slots in the sides of the cylinder formed by the screwing-in plug.



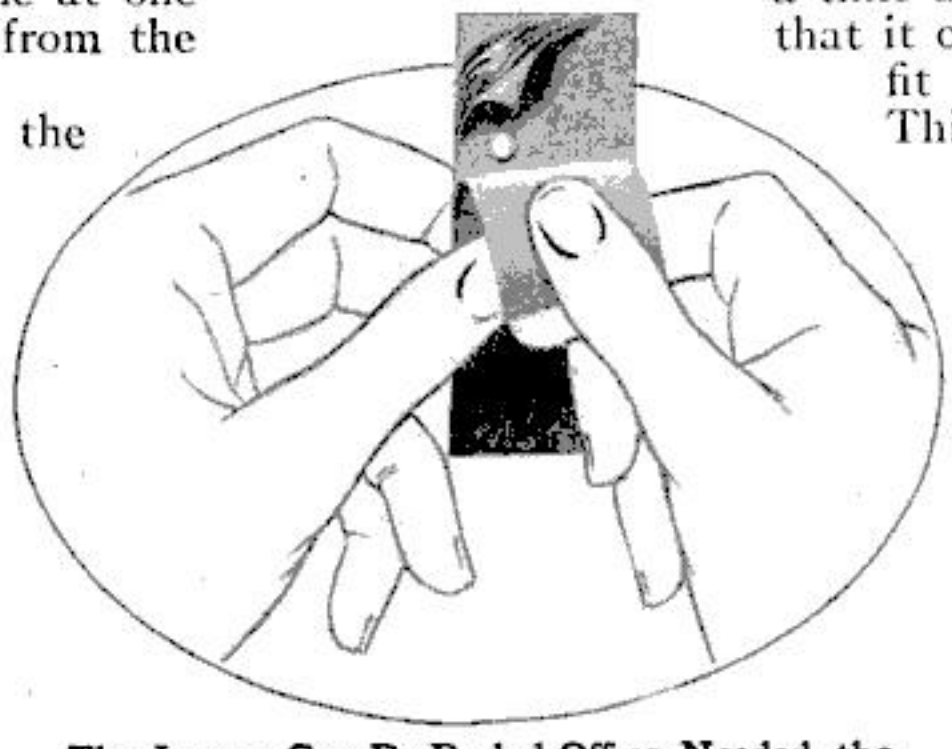
A Compensating Vapor Plug Which Automatically Admits Additional Air to the Cylinder-Manifold

The lower half of the device is provided with a circular hole at one side to admit air from the outside.

The suction in the manifold draws the air out of the upper half of the device above the air-tight washer through the hollow pipe in the small piston. This forms a vacuum above the washer, making the latter assume the position shown by the dotted lines in the cross-sectional view. As the engine speeds up, requiring a leaner mixture, the vacuum above the washer increases, causing the latter to move up still farther until the slots in the piston and the cylinder partly or entirely coincide thus allowing the air in the lower half to pass down into the manifold and mix with the vaporized fuel from the carbureter on its way to the cylinders. As the suction of the engine varies according to the running conditions, the movement of the piston up and down is such as automatically to regulate the amount of air passing through the slots according to the running conditions.

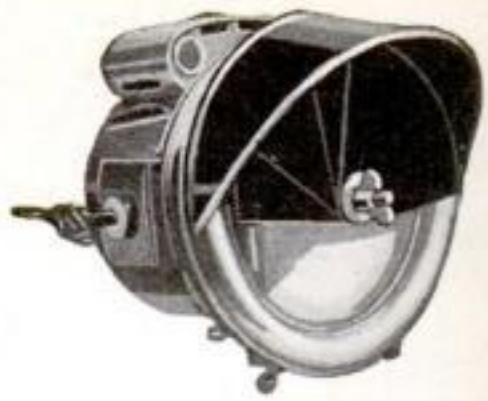
A Shim for Adjusting Plain Bearings in Automobiles

FOR use in adjusting plain bearings in any kind of machinery, the new type of shim shown in the illustration is a time and trouble-saver in that it can be peeled off to fit in a few seconds. This is made possible by the fact that the shim is composed of laminations from 2/1000 to 3/1000-in. thick. These are forced together under great pressure and act as a solid shim, even when several layers have been removed with your thumb-nail.

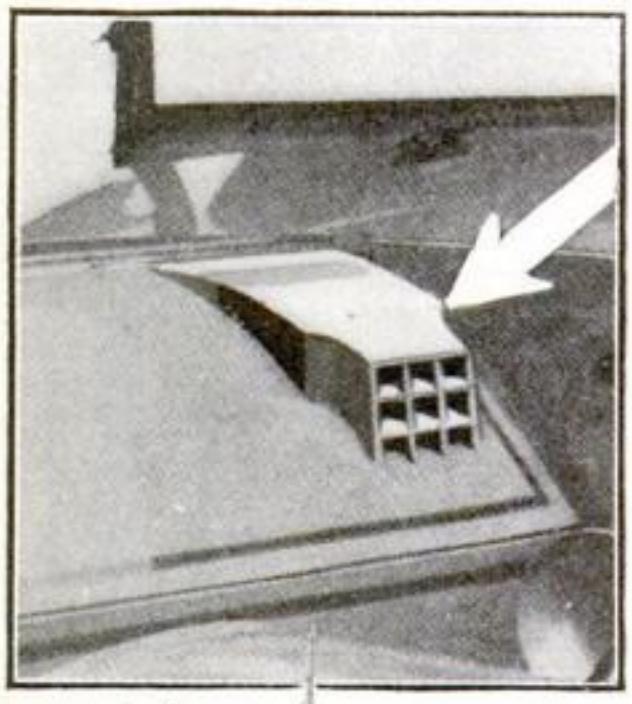


The Layers Can Be Peeled Off as Needed, the Pack Being Still Used as a Strong Solid Shim

Automobile Frills Which Are Making

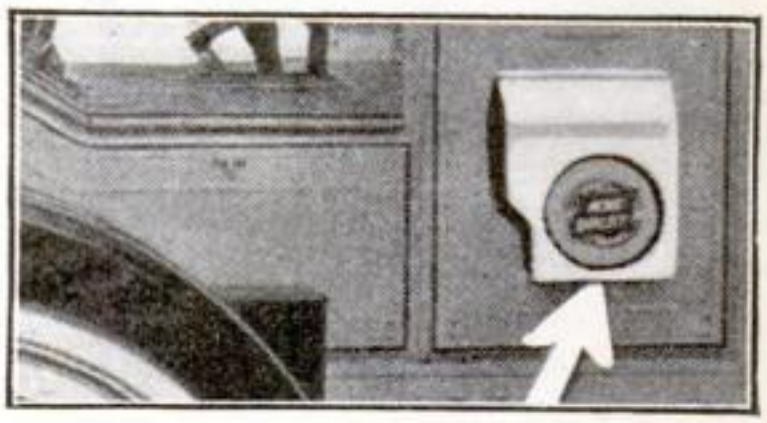


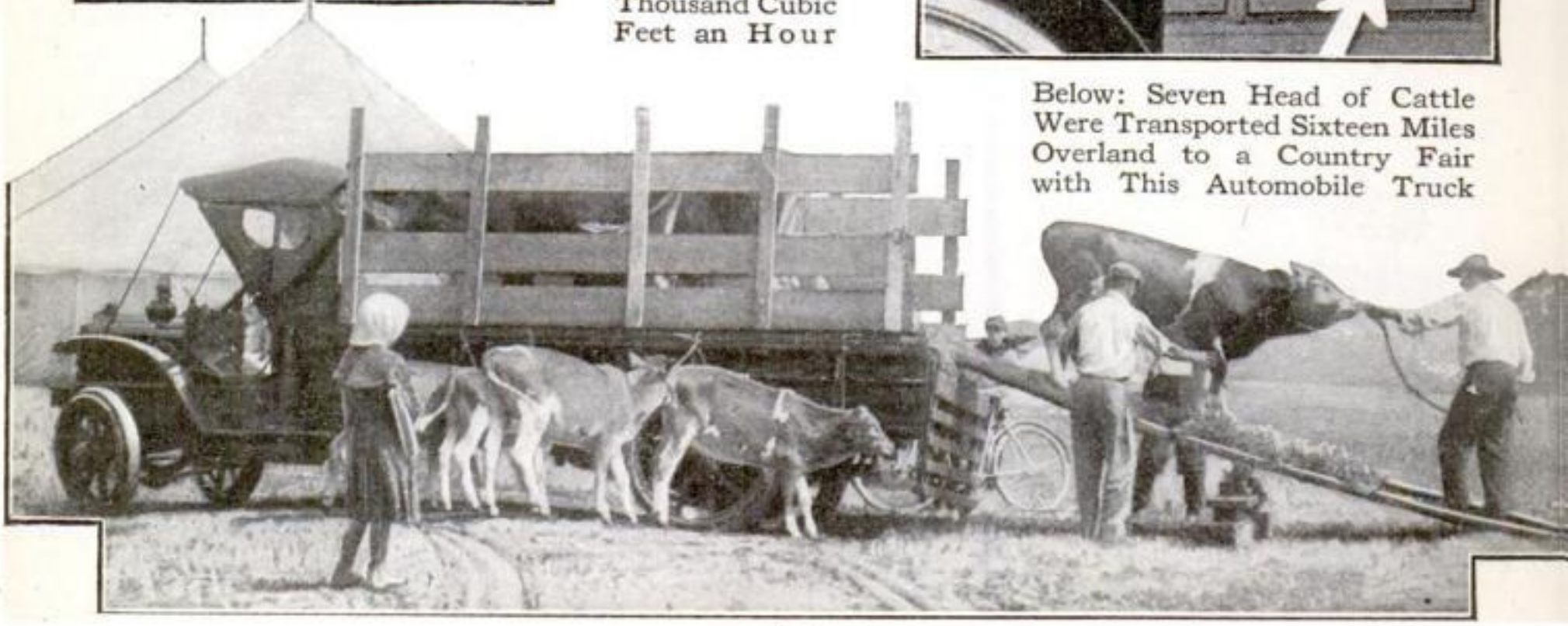
At Right: An Ingenious Headlight Dimming Apparatus Consisting of a Shutter Similar to the Camera Shutter. At Left: An Automobile Bumper Bar and Safety Fender. The Collapsible Network Sections Fold Up Like the Leaves of a Book



At Left: An Exhaust Ventilator to Prevent the Automobile Engine from Becoming Excessively Hot. Four Fluted Vents Are Provided. At Right: When the Automobile Is Traveling the Tubes Draw Out Air at the Rate of Twenty-Five Thousand Cubic Feet an Hour

Above: When the Bumper Hits a Person the Network Drops Down Automatically and Picks Him Up and Does Not Roll or Toss Him



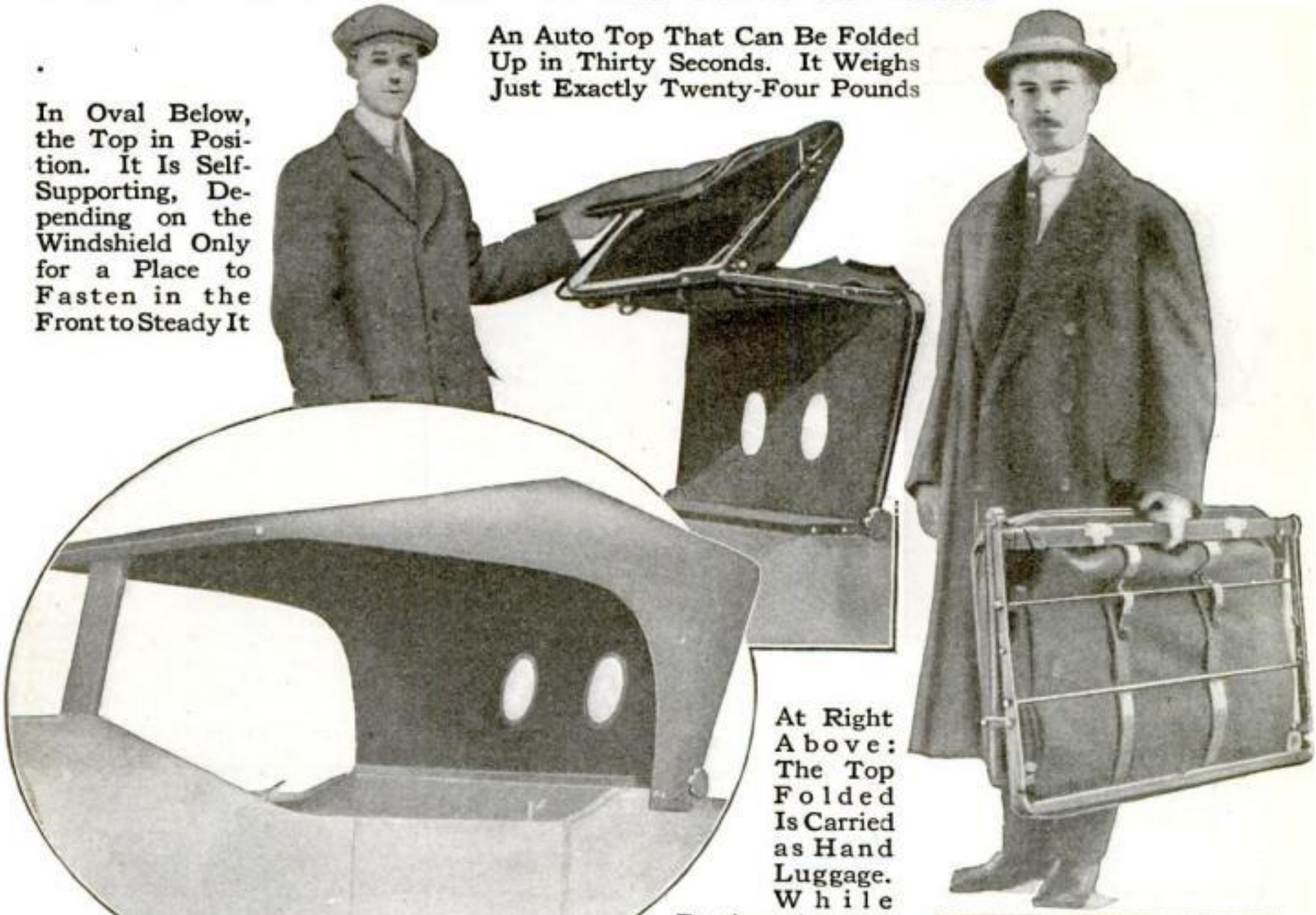


Below: Seven Head of Cattle Were Transported Sixteen Miles Overland to a Country Fair with This Automobile Truck

The Pleasure Car and Truck More Efficient

An Auto Top That Can Be Folded Up in Thirty Seconds. It Weighs Just Exactly Twenty-Four Pounds

In Oval Below, the Top in Position. It Is Self-Supporting, Depending on the Windshield Only for a Place to Fasten in the Front to Steady It



At Right Above: The Top Folded Is Carried as Hand Luggage. While Putting the Top Up It Is Not Even Necessary for the Operator to Get Out of the Car

At Left, a Roll of Towel Paper Which Is Small and Handy Enough to Accompany the Automobile Man on His Trip Carrying with It a Promise of Clean Hands

At Right, a Lock That Controls Both the Spark and Throttle Levers on Ford Cars, Hooking Over One Lever and Being Securely Held to the Other by Means of a Padlock

A Twelve-Ton Tree Stump Which Was Hauled Fifteen Miles Across Country Loaded on a Three-Ton Truck and Trailer

Fifteen Motor-Trucks in One

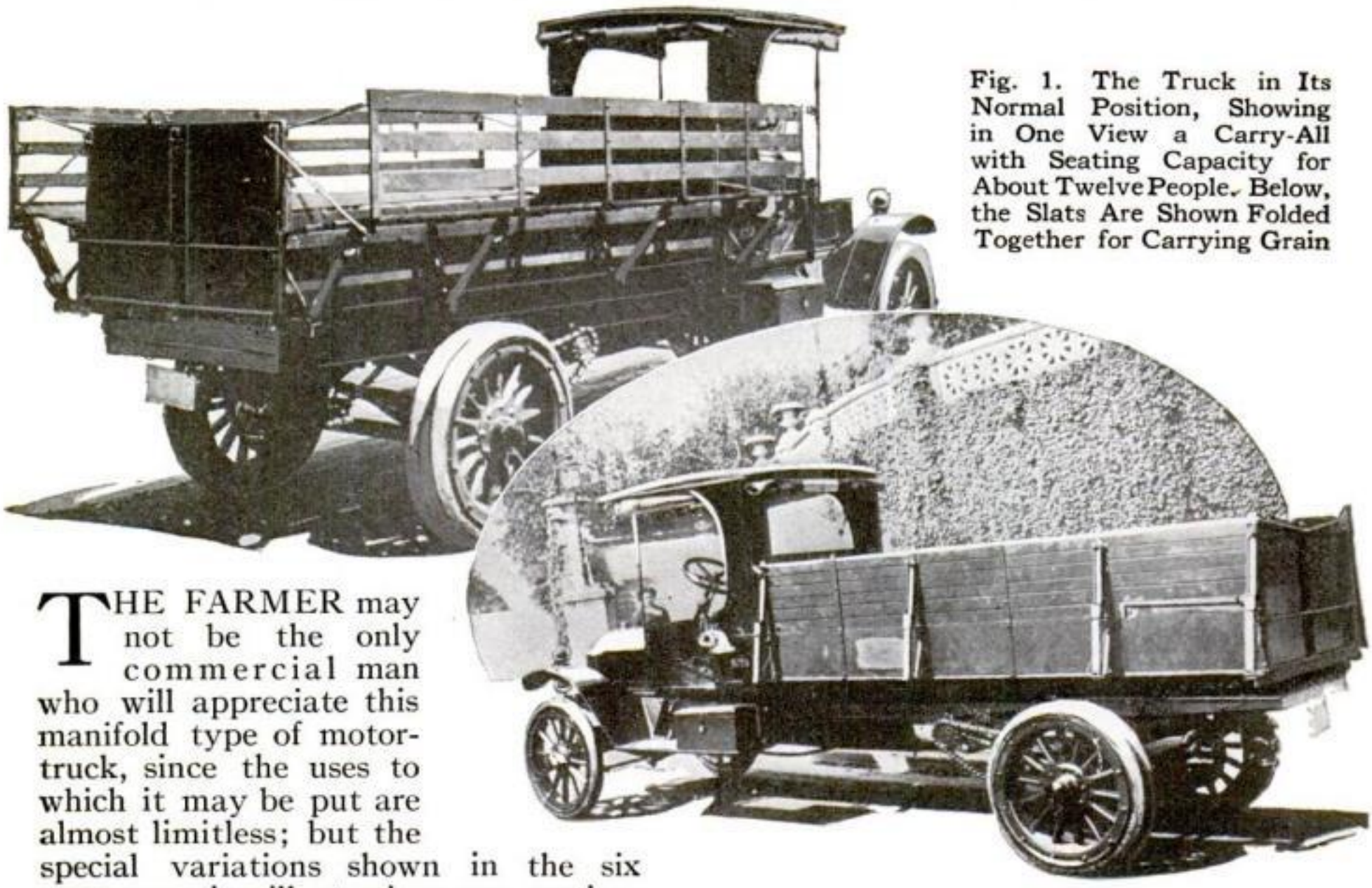


Fig. 1. The Truck in Its Normal Position, Showing in One View a Carry-All with Seating Capacity for About Twelve People. Below, the Slats Are Shown Folded Together for Carrying Grain

THE FARMER may not be the only commercial man who will appreciate this manifold type of motor-truck, since the uses to which it may be put are almost limitless; but the special variations shown in the six accompanying illustrations are particularly adapted to farming.

The specially constructed body, shown mounted on a two-ton truck, is characterized by its folding sides. These are made of slats joined in much the same manner as the folding metal guards between the vestibules of railroad coaches.

The sides may be extended vertically, inclined at an angle to the bottom or laid out flat on each side to form bodies of sufficient size for carrying various kinds of farm produce. The unit is shown in its normal position in Fig. 1, with the sides folded together to form a grain-tight body for oats, corn, bran, etc.

The sides may be extended vertically as in Fig. 2 for carrying live stock like horses or cows and hauling them quicker than they could travel themselves. Fig. 3 shows the unit with flareboard sides for carrying cob corn, potatoes or the like. Rectangular flareboards of the shelf type for holding boxes or barrels of fruits or crates of any description are still another variation of this most versatile vehicle.

Fig. 2. The Sides of the Truck May Also Be Extended Vertically for Carrying Live Stock of Large Size, Such as Horses, Cows and Hogs

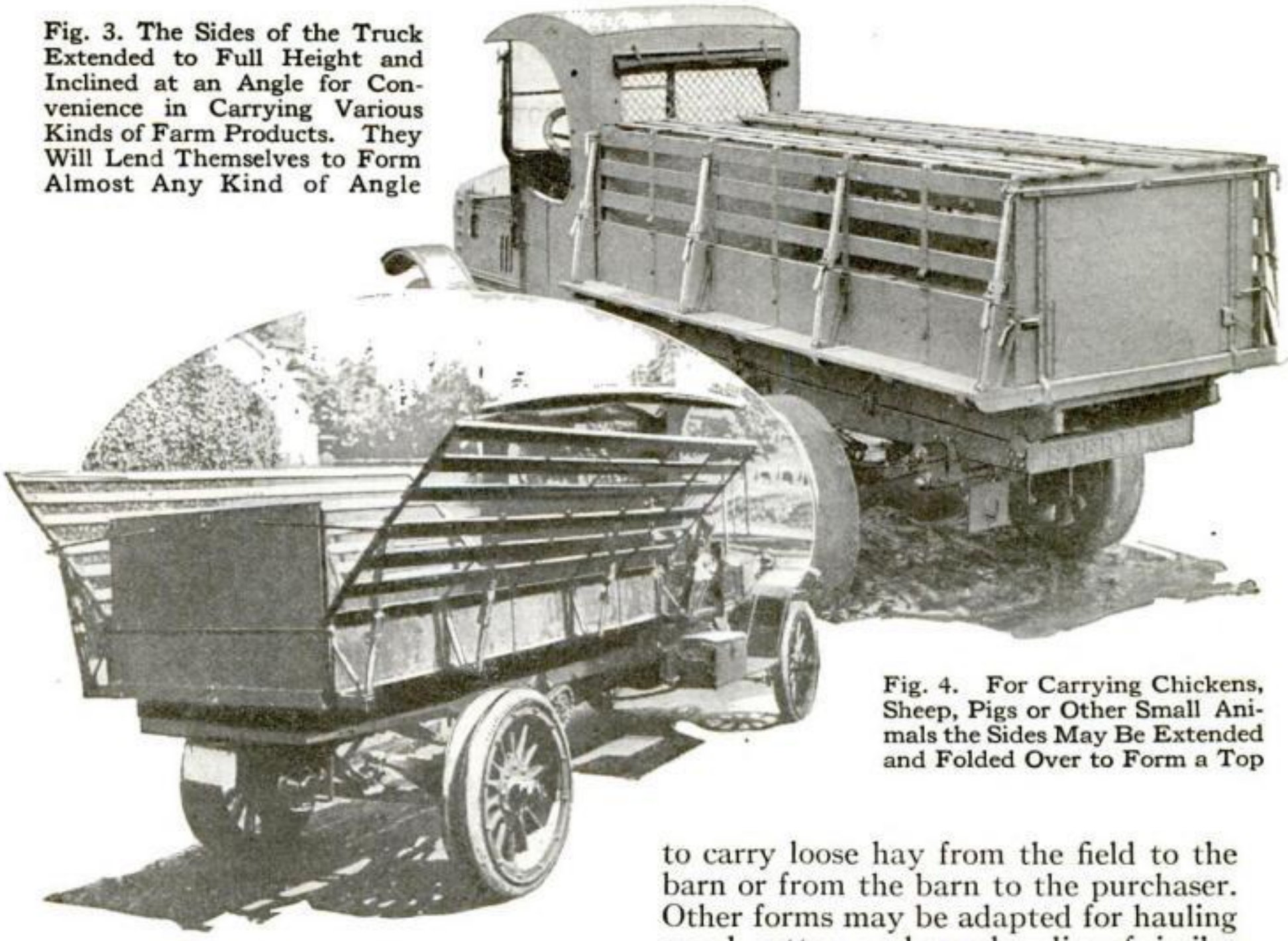


Fig. 3. The Sides of the Truck Extended to Full Height and Inclined at an Angle for Convenience in Carrying Various Kinds of Farm Products. They Will Lend Themselves to Form Almost Any Kind of Angle

Fig. 4. For Carrying Chickens, Sheep, Pigs or Other Small Animals the Sides May Be Extended and Folded Over to Form a Top

The type for empty crates, straw and light products is shown in Fig. 5. For carrying chickens, sheep or pigs, the sides may be extended vertically for a short height and then folded over to form a top, as shown in Fig. 4, preventing the animals from getting out while being transported from place to place.

Besides the shapes pictured, the sides may be extended and folded down flat to carry loose hay from the field to the barn or from the barn to the purchaser. Other forms may be adapted for hauling wood, cotton, and merchandise of similar character.

Another advantage of this type of body is that either one or both sides may be folded down for easy loading and unloading or for selling produce from the vehicle at the market. There are fifteen possible arrangements of the sides and ends which will suggest themselves as the occasions arise. It would require too much space to show them all.

Fig. 5. Extended Flareboard Sides for Carrying Empty Crates, Straw and Other Light Products

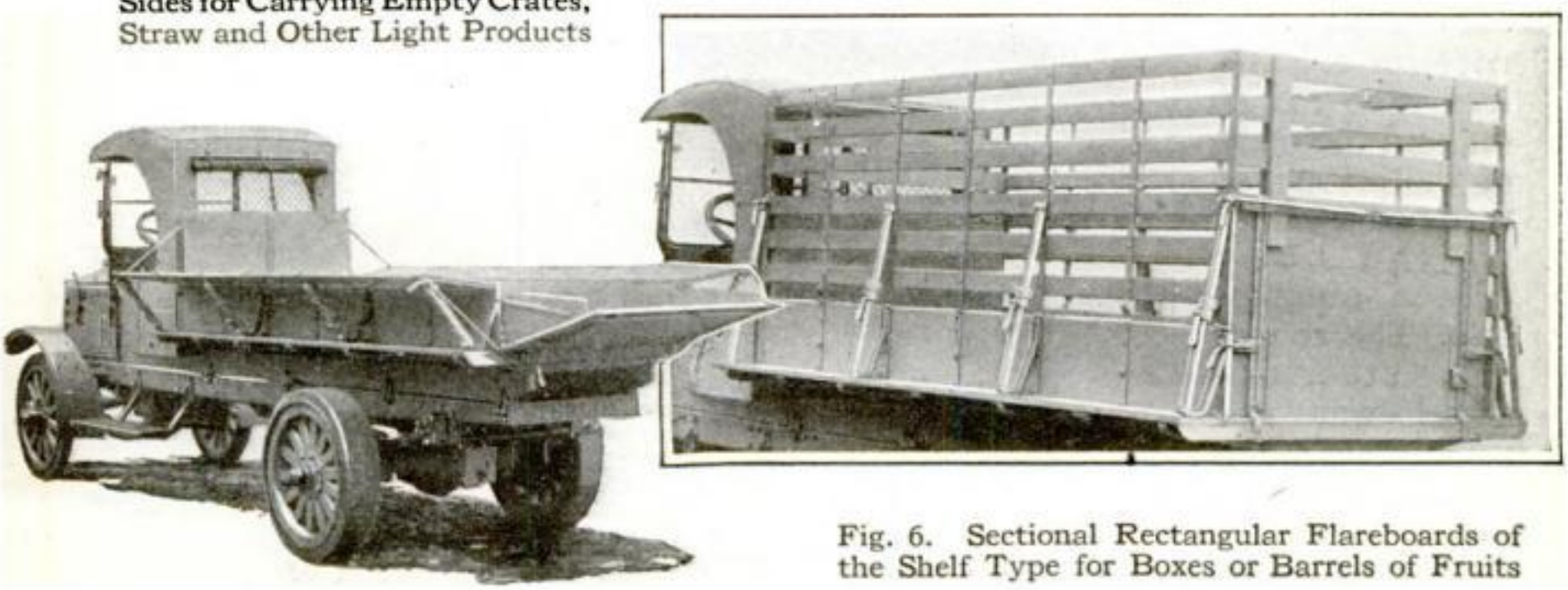
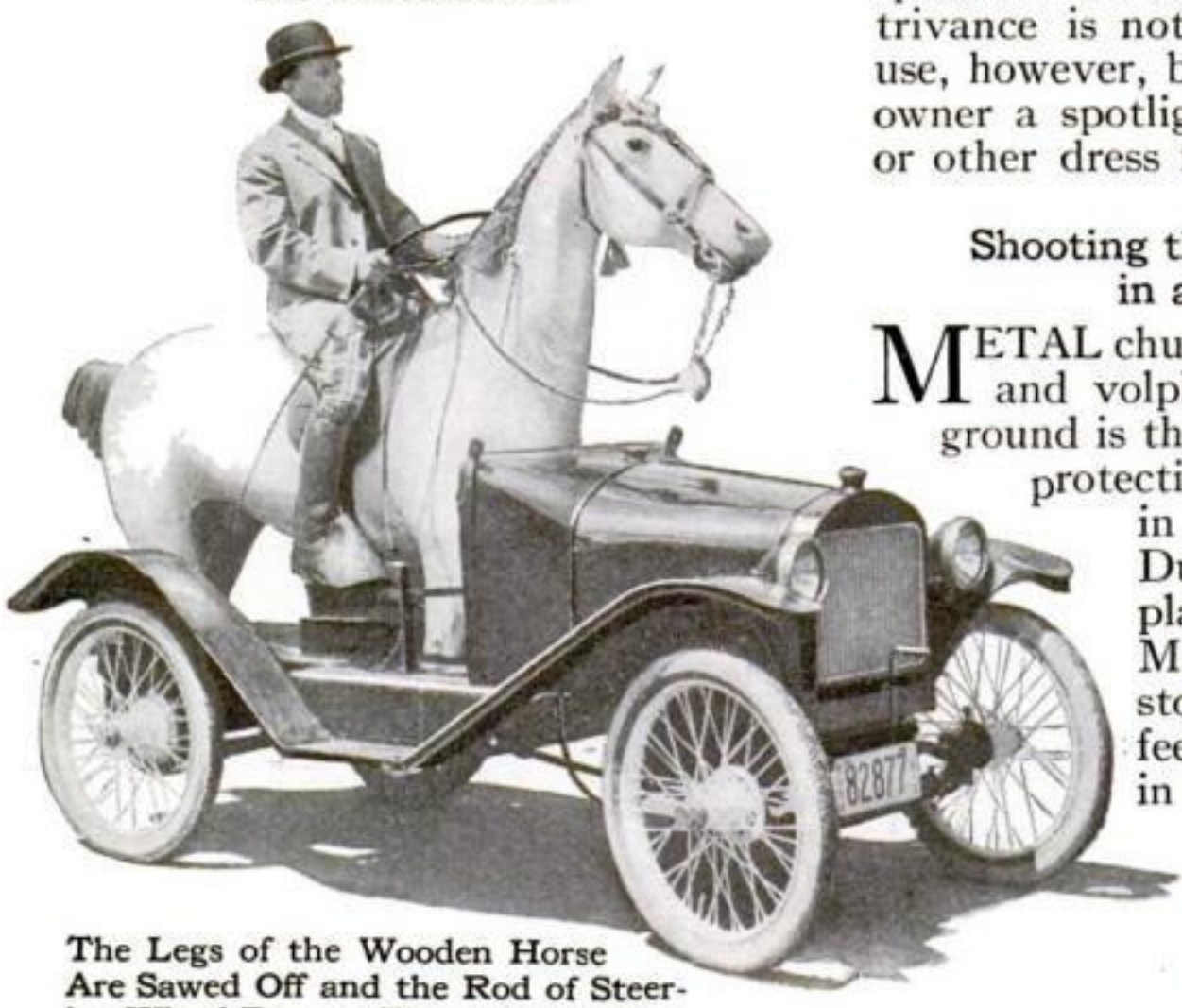


Fig. 6. Sectional Rectangular Flareboards of the Shelf Type for Boxes or Barrels of Fruits

When the Horse Tops It Over the Automobile



The Legs of the Wooden Horse Are Sawed Off and the Rod of Steering Wheel Run up Through Its Chest

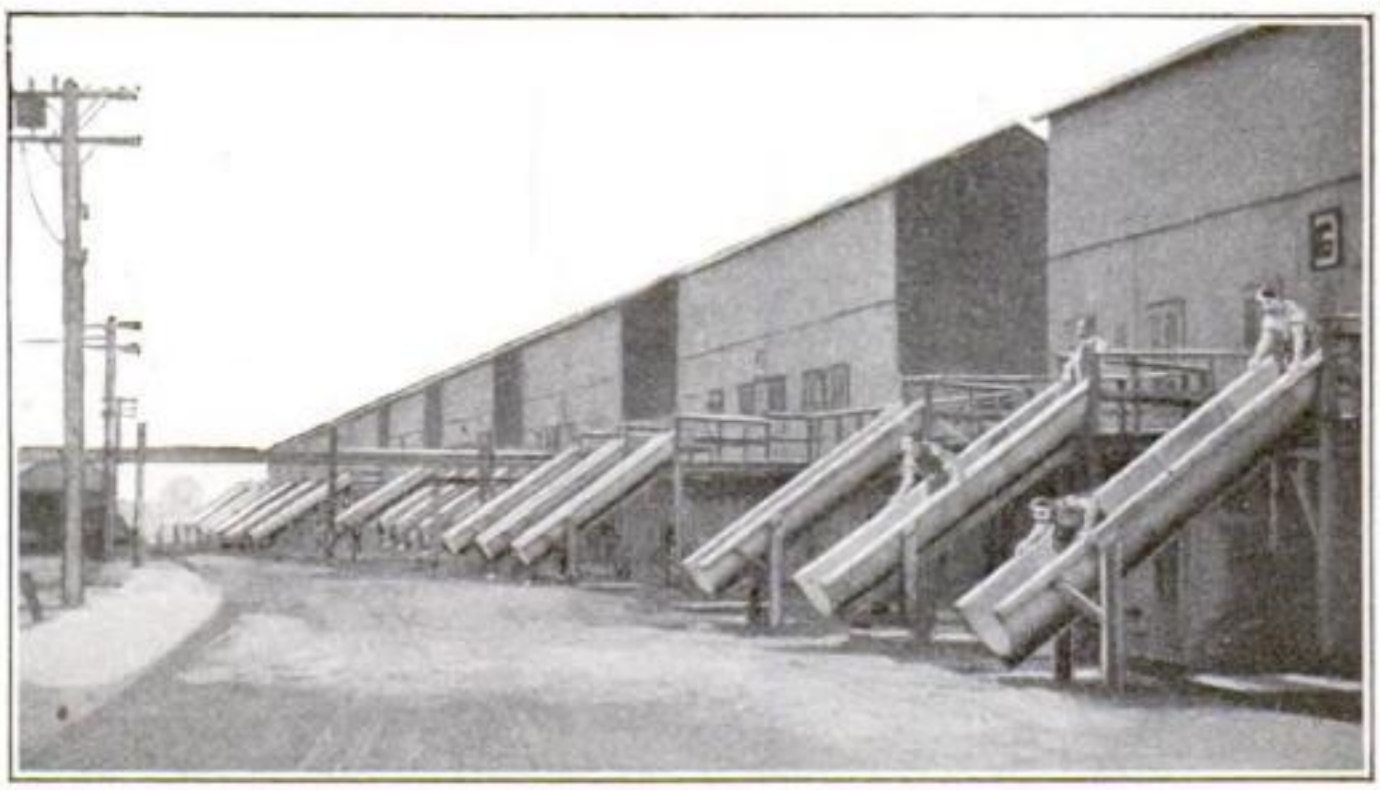
LIVES there a man with soul so dead who never to himself hath said, "What a hero I look on horseback?" Yet the automobile has its fascinations as well as its uses, and in the matter of speed and endurance it passed the horse at the first flag post. A Boston man, however, has evolved an idea for mounting a wooden horse on an automobile and getting the picturesque effect and the little tickling of his vanity without sacrificing the speed of his getting about.

The horse is a discarded harness model which was purchased for the purpose. The legs were sawed off, and the body of the horse was fastened securely to the body of the automobile. The rod of the steering-wheel was run up through the chest of the horse, and arrangement was made for the control of the brakes and speeds in the stirrups. The novel contrivance is not intended for every-day use, however, but merely to make of its owner a spotlight favorite in a parade or other dress feature.

Shooting the Chutes to Safety in an Explosion

METAL chutes to catch the workmen and volplane them gently to the ground is the latest device for giving protection or facilitating escape in case of explosion. At the Du Pont Powder Company's plant at Carney's Point, Maryland, there is a one-story building two hundred feet long that is constructed in sections, each being separated from those on either side by thick brick dividing walls. Should the powder "blow" in one of the sections the workmen in that particular section beat a hasty retreat to a near-by steel fence, behind which they wait.

The fire escapes are nothing more than metal chutes. If something goes wrong on the second floor and it is necessary for the workmen to get out of the building with all swiftness, they simply run for the windows, leap into the chutes, and are shot to the ground with such rapidity that others can fall in line directly behind them and never hit them.

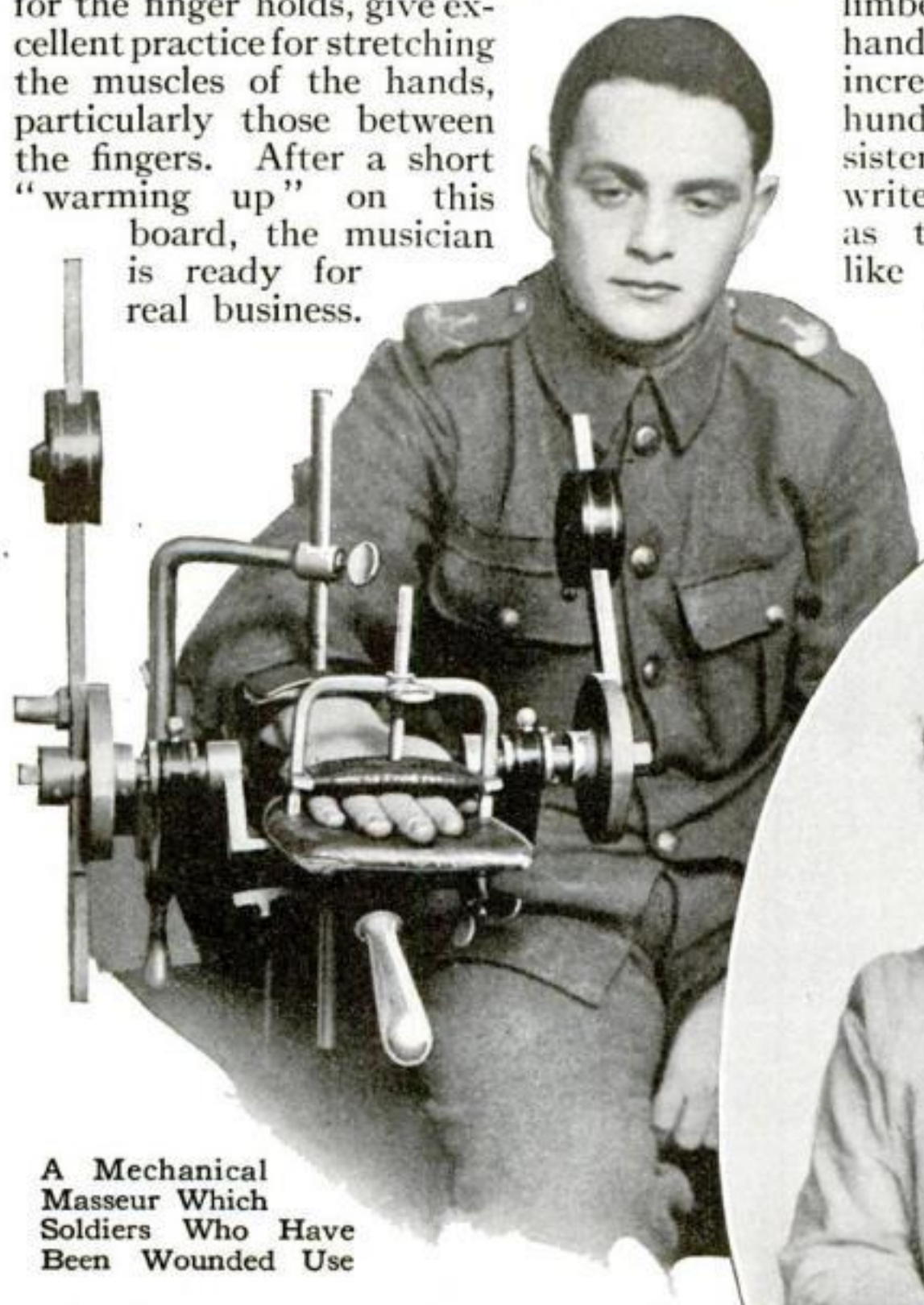


The Workmen Run for the Windows, Leap Into the Chutes and Slide Gently to the Ground in the Fraction of a Minute

If Your Hand Is Too Small—Stretch It

A NEW instrument has been invented for musicians. It is intended to be used by pianists and volinists in particular, to exercise their hands and to enlarge them. Physicians, too, will find the invention useful as a massaging device.

The instrument is fitted with grooves for finger holds which move across the board by means of elastics. Pegs set apart for the finger holds, give excellent practice for stretching the muscles of the hands, particularly those between the fingers. After a short "warming up" on this board, the musician is ready for real business.



A Mechanical Masseur Which Soldiers Who Have Been Wounded Use

The instrument was also invented for the purpose of improving the structure of the hands and it is being used in the accompanying picture on the right for that purpose.

Musicians do not view these devices with unqualified approval. Unless judiciously used they may even do harm. The famous composer Robert Schumann tried to improve his hand with a mechanical device and injured himself to such an extent that he could never play the piano so well again.

Various devices are now in general use to exercise the crippled fingers of wounded soldiers. They perform the work of *masseurs* with tireless patience and with an effectiveness that is truly astonishing. One of them is shown in the illustration on the left.

Expert typewriters and telegraphers are also adopting mechanical means for limbering up the muscles of the hands. It is said that a typist can increase her speed to nearly two hundred words a minute by persistent exercise—not on her typewriter, but with some such device as those illustrated. However, like all gymnastics, mechanical massage must be indulged in very judiciously, preferably under the direction of a professional instructor, so as to avoid all danger.

Her Fingers Were So Short She Could Not Stretch an Octave on the Piano Formerly

A Castle Built of Coal to Advertise the Resources of Tennessee

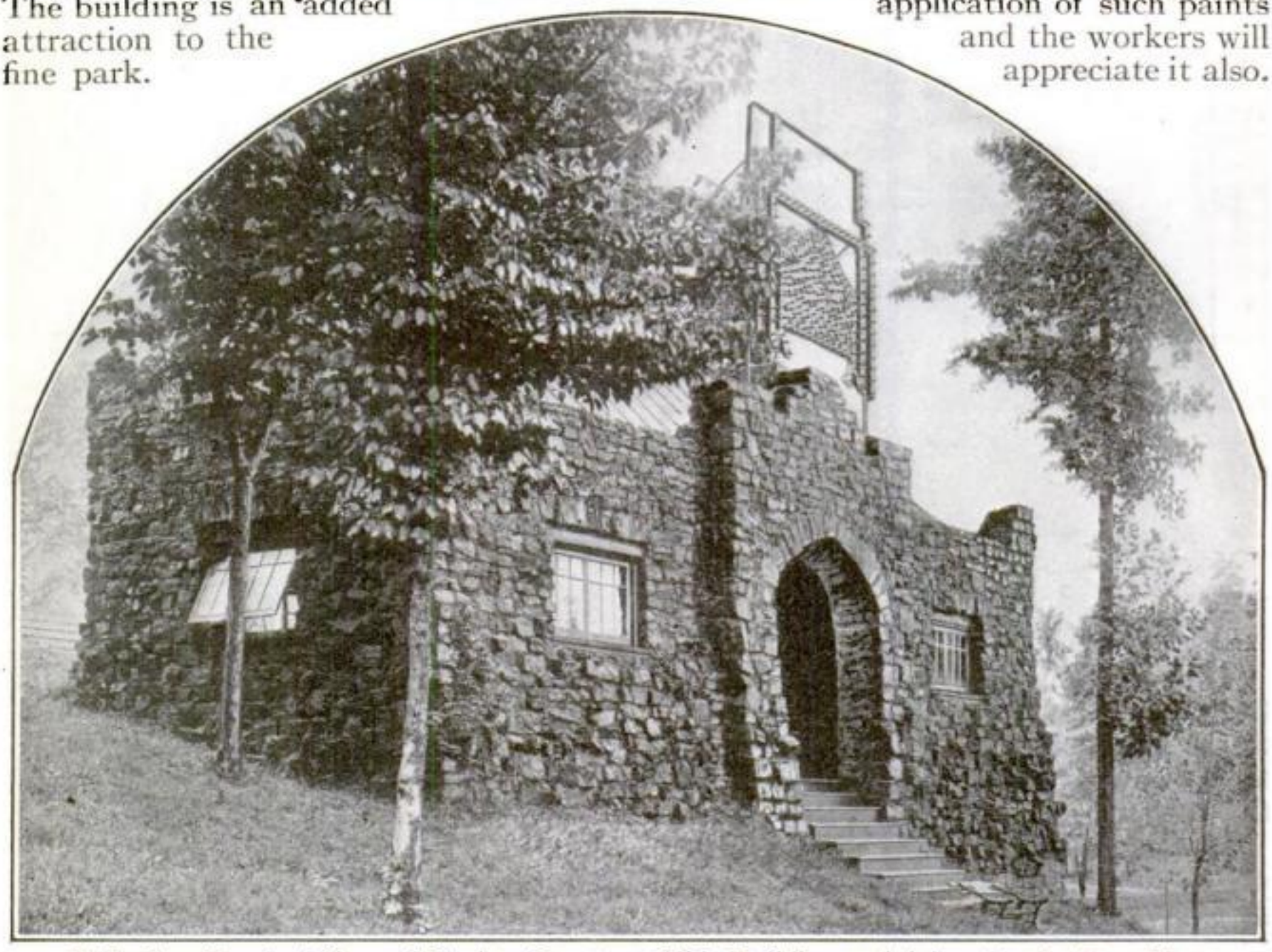
KNOXVILLE, Tennessee, has a very practical and effective way of advertising the great natural resources of that section of the state. In Chilhowee Park, the principal recreative center of Knoxville is a veritable coal castle.

The building is constructed entirely of coal, more than a hundred tons of the mineral having been employed for the purpose, although it is only one story high with a one-room interior. The usual belief that coal is not impervious to the inroads of the elements has been very effectually disproven, because the building erected several years ago is showing no serious sign of falling into disrepair.

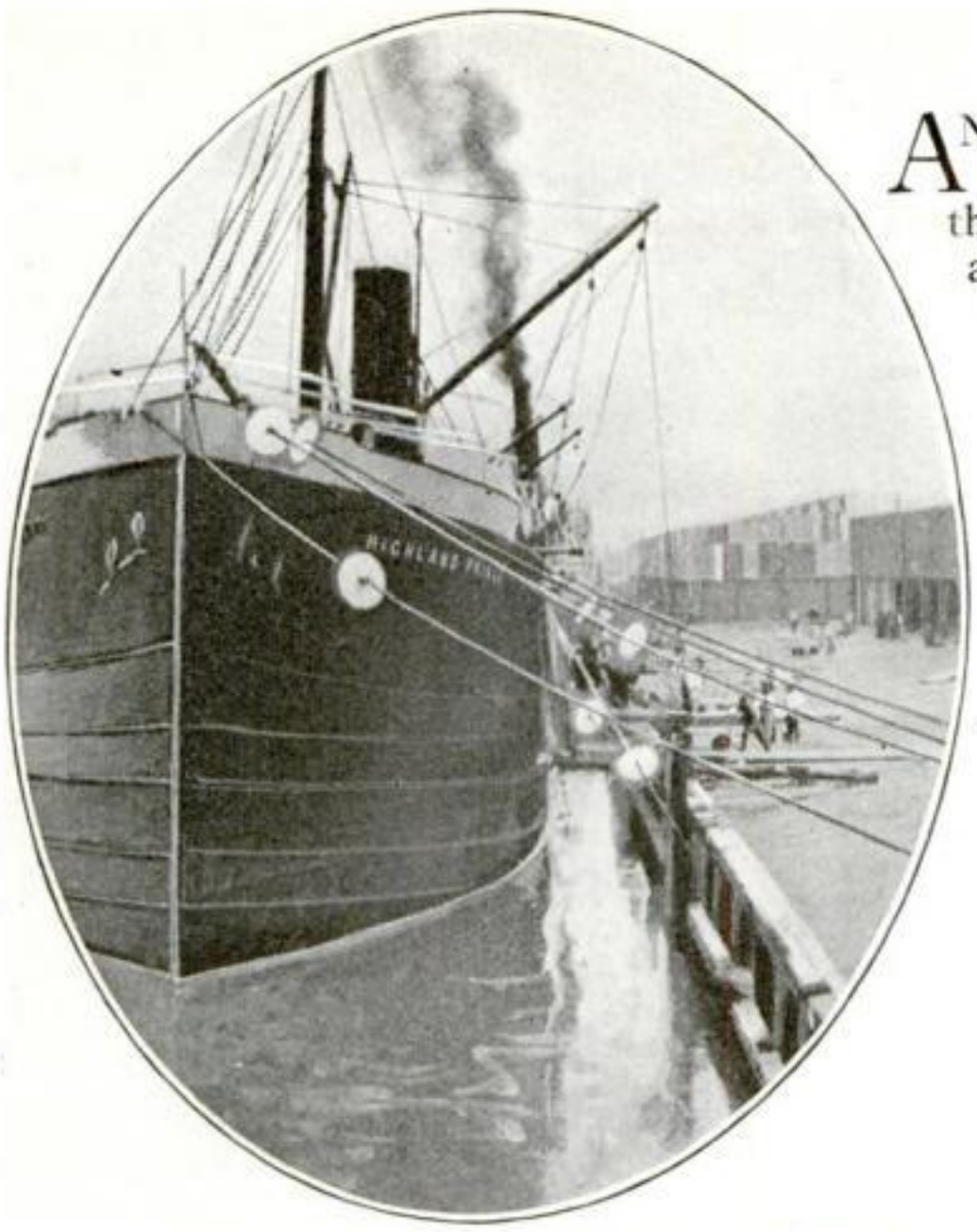
In addition to advertising the fact that Knoxville is in the center of a great coal producing section, the coal castle also affords the advantages of a rest room in the park. The appearance of the structure is decidedly picturesque in its glistening, weather-polished black. The building is an added attraction to the fine park.

Cutting the Cost of Illuminants by Wall Treatment

THE illumination of factories, railroad terminals and department stores has been given great consideration of recent years; increased output, improved workmanship and a minimum of accidents having resulted in nearly every instance where better lighting systems have been installed. In such places, wall treatment as a means for conserving the illumination afforded by modern illuminants has generally been adopted. These advances have come as a result of practical observations, which show that the rays from powerful lights, falling upon dark brick or stone walls, give less light to a room than the rays from less powerful lights falling upon similar walls that have been painted in light colors with dust-resisting, washable paints. From the standpoint of economy it is of interest to record the fact that the monthly cost of illuminants for lighting dark-walled factories may be enormously reduced by the occasional application of such paints and the workers will appreciate it also.



It Took a Hundred Tons of Coal to Construct This Building and Advertise the Fact That Knoxville, Tennessee, Considers Coal to be One of Her Greatest Natural Resources



The Rat-Guard Is a Circular Disk of Galvanized Iron About Eighteen Inches in Diameter

A Guard for Mooring Ropes to Prevent Rats from Landing

TO prevent rats from bringing the bubonic plague into New Orleans a city ordinance requires all boats from tropical zones to "fend off" about twenty feet from the wharf and to put a rat-guard on each mooring rope. The rat-guard is a circular disk of galvanized iron about eighteen inches in diameter which keeps the rat from using the rope as a bridge and making a landing on the wharf.

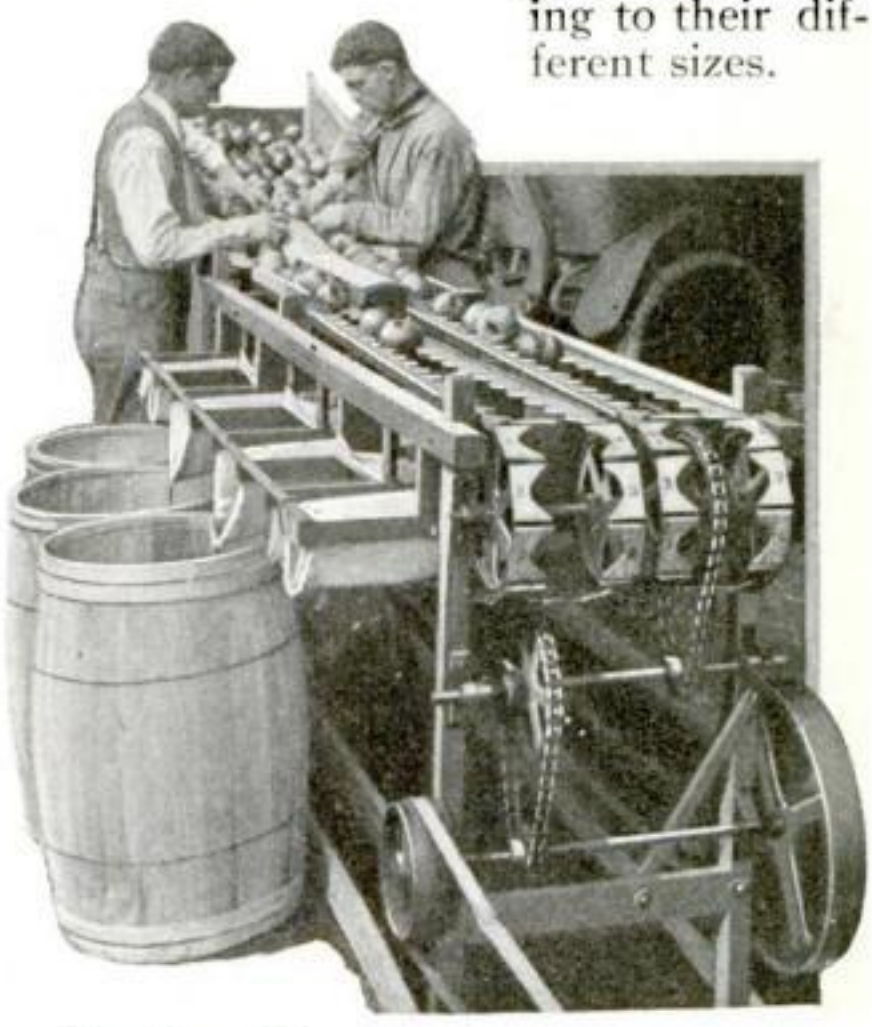
In the accompanying photograph one rat-guard appears as a white circular spot near the bow of the boat. Others may be seen attached to nearby ropes. The boat at dock is the *Highland Prince* with a cargo of coffee from Brazil.

Formerly these incoming ships brought as great a cargo of rats as they carried of grain, figuratively speaking, which proved to be a nuisance as well as a grave menace to the health of the port and of the surrounding country.

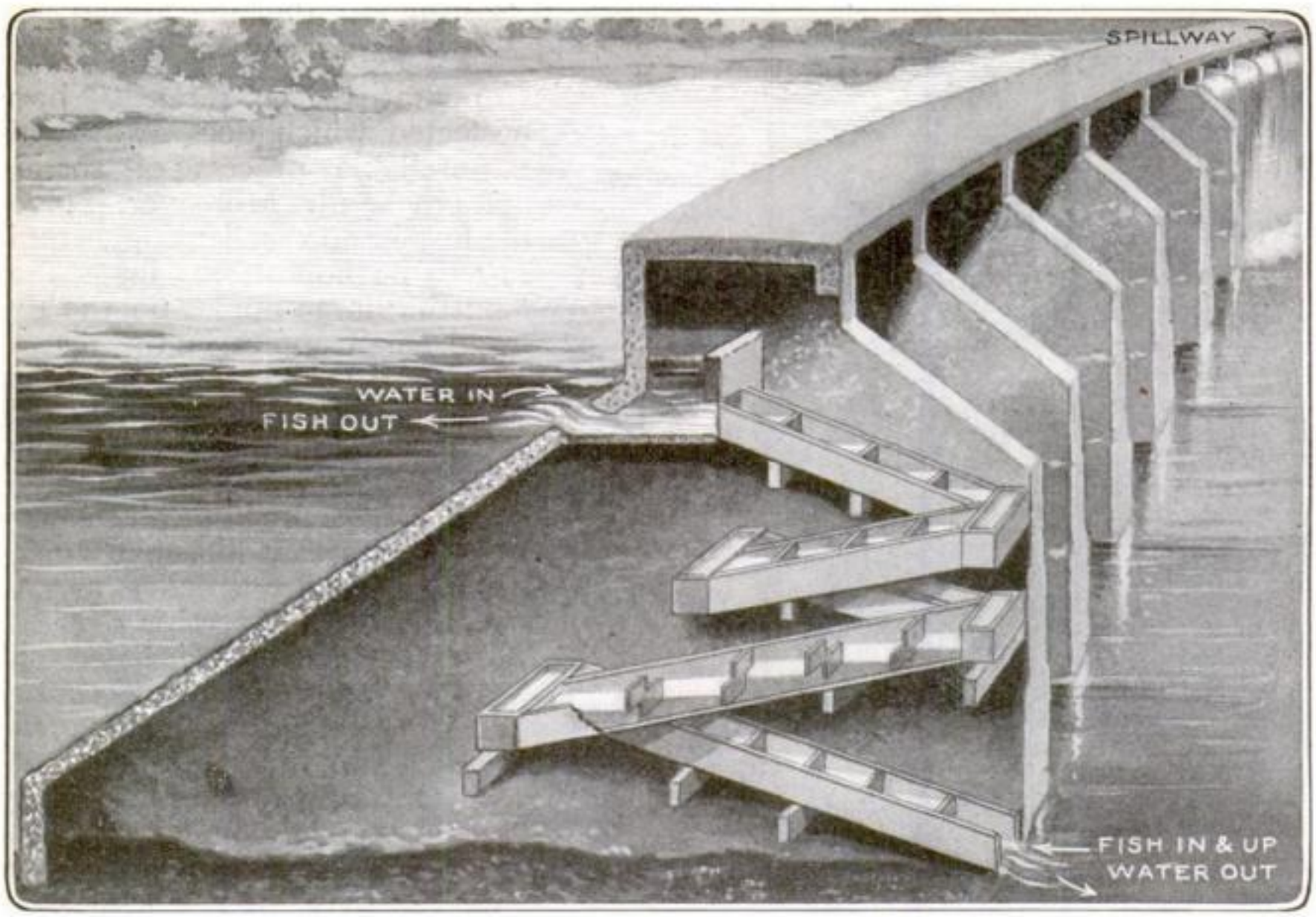
Sorting and Packing Apples by Machinery

AN apparatus has recently been perfected which does away with the unreliable process of sorting apples by hand. Moreover, it gives the farmer an excellent opportunity to be honest, for instead of putting large apples on the top and small apples in the rest of the barrel, he can sort them according to an honest standard, and eventually get better prices, for people will learn that his large apples are large all the way down, and that his small apples don't get any smaller as the bottom of the barrel is reached.

The machine which accomplishes so accurately and simply this task of sizing involves the use of two queer looking belts which are divided up into many small segments, the segments each having a wide mouth in their center. As the belts move from one end of a flat table to the other the mouths open wider and wider, and the apples which have dropped upon the segments, finally fall through the widening mouths. They fall at different places according to their different sizes.



The Two Belts Are Divided into Many Small Segments Each with a Wide Mouth



The Water in the Ladder is Continually Flowing Down and Out, Forming a Running Stream up Which the Fish May Swim, Jumping from One Pool to the Next Higher One

How Fish Jump 100-Foot Dams

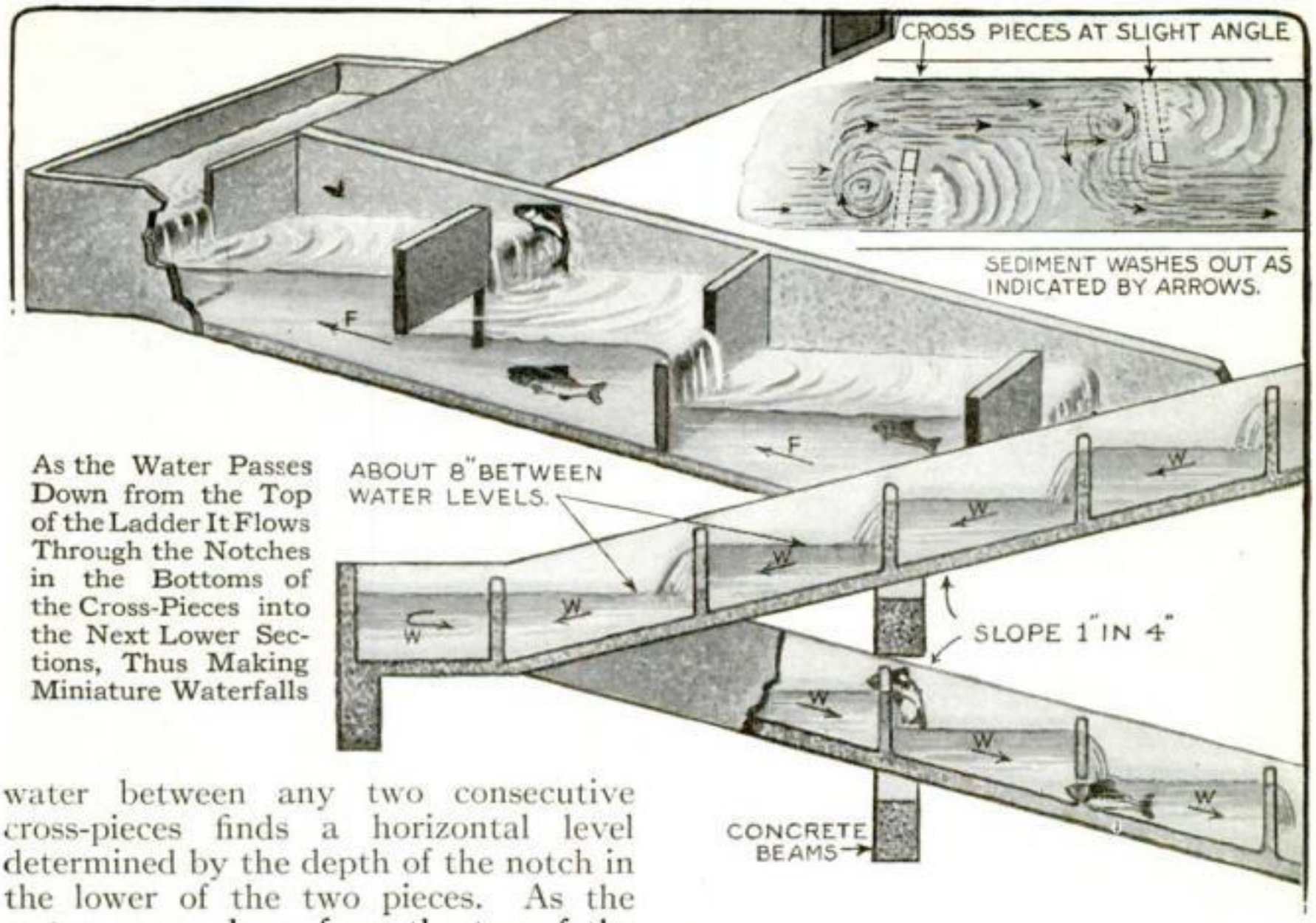
DO you know that fish actually jump one hundred-foot dams in their migrations each spring to the headwaters of the rivers in which they spawn? Of course, this one hundred-foot jump is not made all in one leap, but in a number of short leaps of eight inches each. This feat is made possible by what is called a fish ladder.

This ladder must be placed in all river dams in which fish such as salmon swim up to the river heads to spawn. Fish will not spawn anywhere except in the still headwaters, and it is necessary that they arrive there with the least exertion. The government makes it obligatory that at least one fish ladder be built into every dam across such rivers.

Fish ladders, while they may be built of wood, stone or concrete, according to the material of which the dam is constructed, are all alike in principle and consist of a trough which begins at water level on the low side of the dam and then extends upward in several zig-zag steps to a point below the water level on the up-side of the stream. Water enters at the top end and flows down and out at the bottom. Its flow, however, is not free like that in a sluice, but is retarded by means of cross-pieces at regular intervals in the trough.

The accompanying illustrations show a reinforced concrete fish ladder built in the most modern type of dam of concrete construction. The cross-pieces are also made of concrete and form small pools of water between consecutive pieces. Each cross-piece is set at a slight angle to the sides of the trough, alternate ones being slanted in opposite directions. Each piece has a rectangular notch cut in the top and another in the bottom on the opposite side.

Alternate pieces have the two notches placed on opposite sides, respectively, as shown in the detailed perspective drawing. The trough being inclined, the



As the Water Passes Down from the Top of the Ladder It Flows Through the Notches in the Bottoms of the Cross-Pieces into the Next Lower Sections, Thus Making Miniature Waterfalls

water between any two consecutive cross-pieces finds a horizontal level determined by the depth of the notch in the lower of the two pieces. As the water passes down from the top of the ladder it flows through the notches in the bottoms of the cross-pieces and also drops over the top notches in the cross-pieces into the next lower sections like small waterfalls.

The water in the ladder is continually flowing down and out at the bottom, forming a running stream up which the fish may swim with a choice of passing from the first pool to the next and so on up by swimming through the bottom notches or jumping through the top notches from one pool to the next higher one. The jump in the latter case is not more than eight inches and can be done easily by almost any kind of fish.

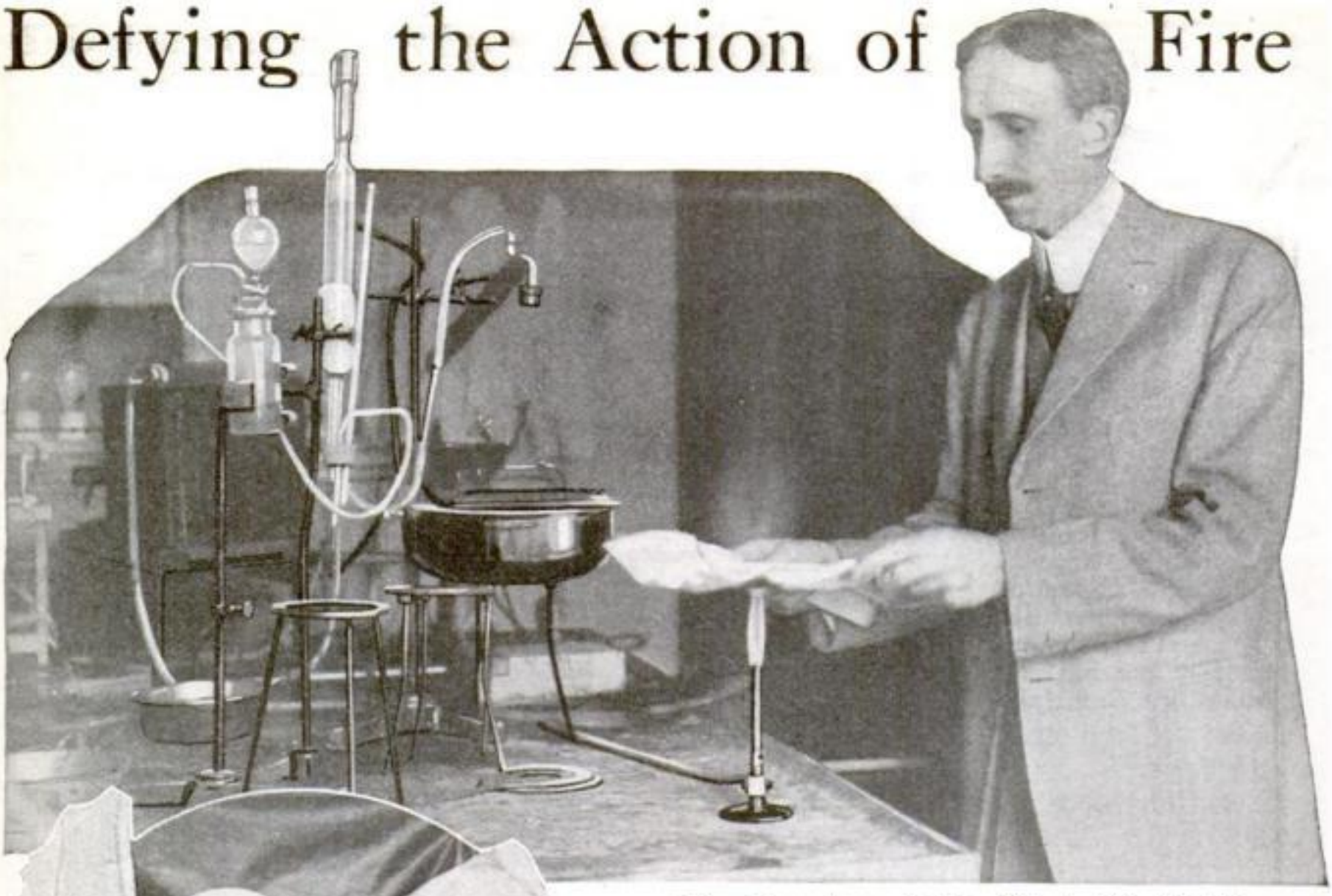
It is noted in the plan view of the ladder shown in the accompanying drawings that the notches in the bottom of the cross partitions are placed at the lower end of the partitions to permit any sediment to be washed out by the flow of water. In the large drawing it is also to be noted that the ladder is not placed in close proximity to the spillway. The reason for this is that fish in trying to ascend a dam seek to pass up the largest stream of running water. Due to the fact that the volume of running water issuing from the ladder is usually less than that dropping over the spillway, the fish would not find the ladder readily if it were close to the spillway but would try to swim up the spillway and would probably dash themselves to death against the concrete buttresses.

Borrowing the Night Lamps of the Fireflies

Just what the secret of the firefly's light is the scientists have not as yet discovered. Three necessary factors have been found—water, oxygen and a photogenic or light-producing substance; but a fourth is probably involved which has thus far defied all research. The children say it is the fairy lamplighter whose wand lights the little lamps that add so much to the beauty of a summer's night. However, a method has been evolved of extracting and drying the light-producing organs of the firefly without impairing the power of the substance to phosphoresce.

The dried material may be extracted with water-free solvents. It is ground up into a powder, and water containing oxygen is added; which gives the golden glow without the assistance of either the firefly's will or the fairy's wand.

Defying the Action of Fire



The Inventors Claim That All Building and Household Materials and Even Ordinary Paper Can Be Made Non-Inflammable

A LIQUID that resists the action of fire and water and renders all inflammable materials absolutely fire-proof has been perfected in the pharmaceutical laboratories of the University of Iowa. When wood, cloth, or paper are saturated with it and then dried, an insoluble mineral material is left in the cells of the fiber which makes combustion impossible. The drying may be spontaneous, or, in the case of wood, may be done in a kiln.

As a test, a block of wood which had been soaked in the new preparation and afterward dried resisted the flame of a Bunsen burner for one hour, whereas a similar block of untreated wood was burned to ashes in exactly nine minutes. The flame of a Bunsen burner gives a much greater heat than an ordinary fire—from 700 to 1,000 degrees Fahrenheit. The board was slightly charred over the area struck by the flame and a hole about five-sixteenths of an inch in diameter was made, but at no time did a blaze appear. Ordinary paper, gun cotton, and other highly combustible stuffs, when similarly treated, failed to burn.

Rainfall, running water, climatic conditions and all sorts of weathering agents do not appear to affect the residue of the solution in the slightest degree. The pine board, which resisted the Bunsen burner for an hour, was placed under a heavy running stream of water for twenty-four hours after the solution had dried on it. Strips of ordinary toweling were treated with the liquid and then placed in windows and exposed to rain and dew, but this did not affect their resistance to fire. This is an improvement on fire-proofing materials now on the market, which are soluble and only serve to retard the destruction of fire.

Exterminating Mosquitoes

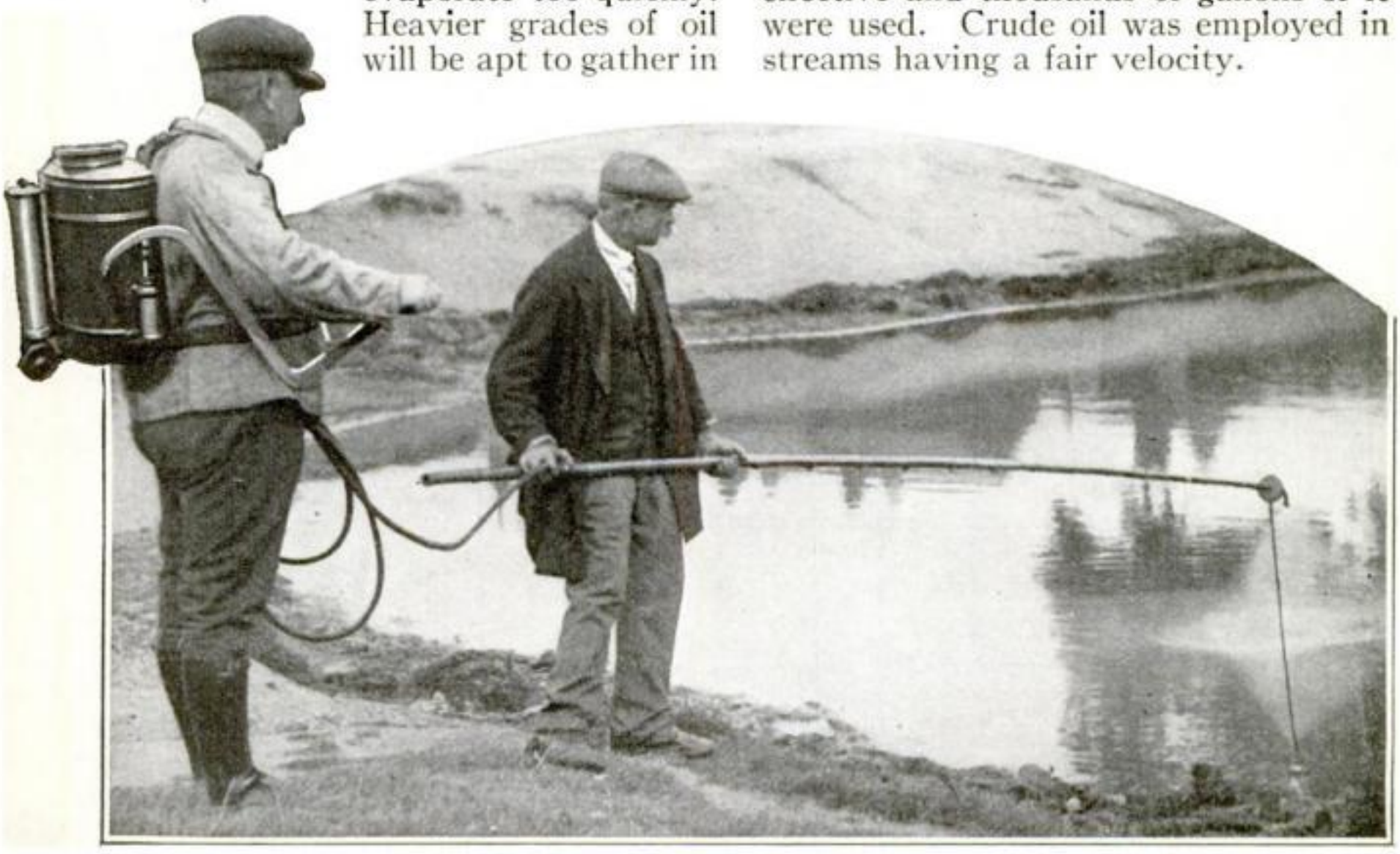
NEXT to draining, the best way to abolish mosquito breeding places is to treat the water so as to kill the mosquito larvae and while many substances have been tried for this purpose, nothing has given such good results as petroleum, according to experts of the United States Department of Agriculture. Common kerosene of low grade is most satisfactory as regards efficiency and price.

It has been found that spraying with a portable pump is the best way to use the oil. Small ponds, however, can be sprinkled out of an ordinary watering-pot with a rose nozzle, or for that matter pouring it out of a dipper or cup will be satisfactory. In larger ponds pumps with a straight nozzle may be used. A straight stream will sink and then rise and the oil will spread until the whole surface of the water can be covered without waste.

In choosing the grade of oil to be used two factors must be considered; it should spread rapidly and should not evaporate too quickly. Heavier grades of oil will be apt to gather in spots and the coating will be necessarily thick. It has been found that one ounce of kerosene is sufficient to cover fifteen square feet of surface, and in the absence of wind, such a film will remain persistent for ten days. Even after the iridescent scum apparently disappears there is still an odor of kerosene about the water. A mixture of crude oil and kerosene has been found to be effective in killing mosquito larvae. It has one very decided advantage over pure kerosene which is that it does not evaporate so quickly.

Special attention should be paid to little pockets of water that form around the edges of ponds, for it is in such places where the water is not disturbed by wind or otherwise that the larvae breed in greatest numbers. Larvae do not breed in open stretches of water where the surface is rippled by the wind.

In the fight against the mosquito in Panama, the government experts found that a larvicide composed of carbolic acid, rosin and caustic soda was very effective and thousands of gallons of it were used. Crude oil was employed in streams having a fair velocity.



Covering the Surfaces of Ponds and Other Breeding Places with Petroleum, According to Experts of the Department of Agriculture, Is the Best Move Against Mosquito Larvae. The Illustration Shows a Pond Being Sprinkled with Petroleum from a Portable Pump

Raising Parasites to Fight Pests

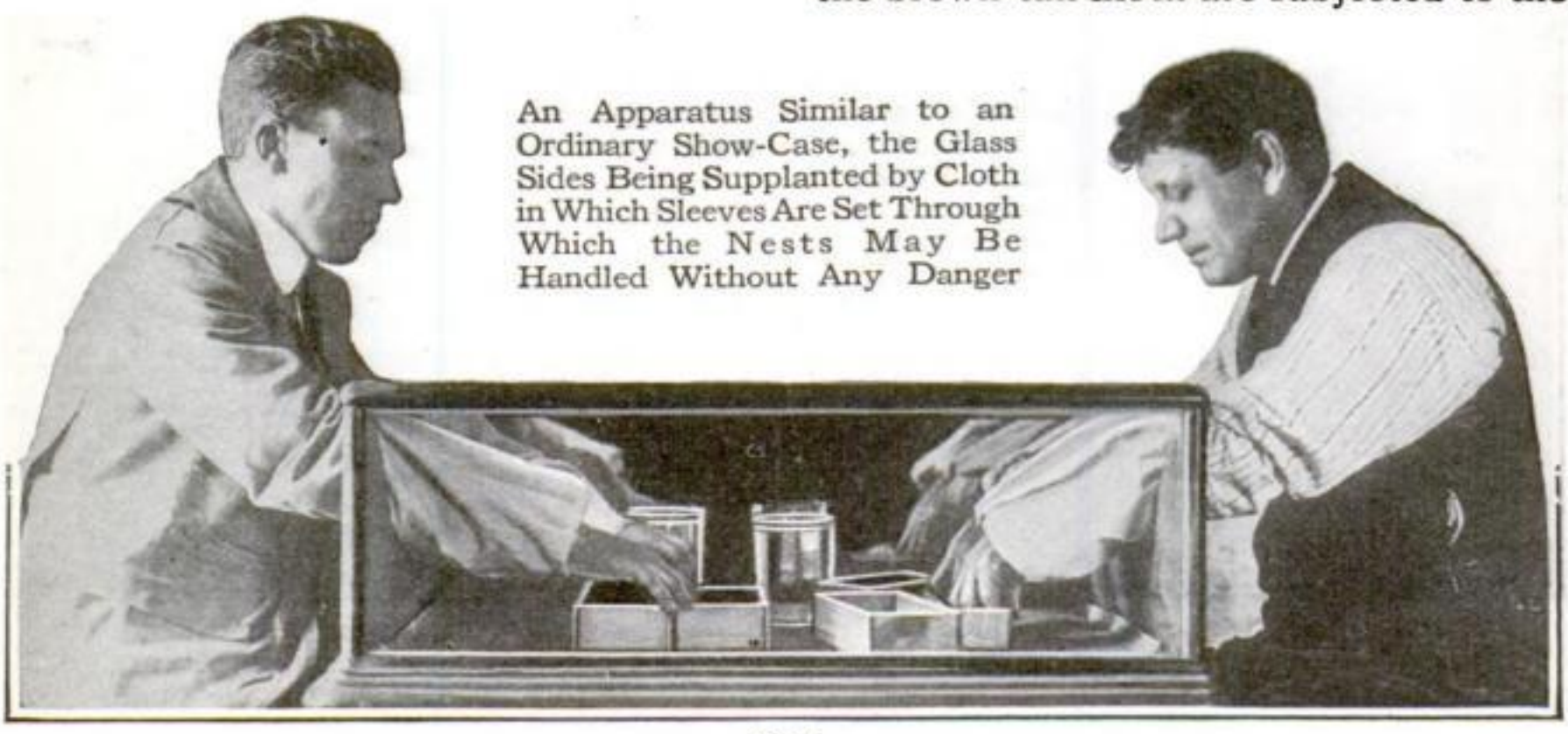
Structure Erected in Connection with the Parasite Laboratory Where the Gypsy Moth and Other Pests Are Trapped and Studied

MANY methods of exterminating injurious insects have been tried, some proving useless and others, while effective, being only temporarily so. Perhaps the most scientific work yet attempted is the cultivation of natural enemies, which in time would annihilate the insects upon which they live. The gipsy moth and brown-tail moth are particularly injurious. Both are natives of Europe and were early introduced into Massachusetts, where they have committed yearly ravages on fruit and shade trees. Can no enemy which will devour them be found?

In 1905, work was begun under Federal supervision to answer that question. Dr. L. O. Howard, chief of the Bureau of Entomology, and Dr. W. F. Fiske, in charge of the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass., have expended time and energy in their unceasing efforts to rid the country of these harmful insects.

While at least a dozen parasites have been reared from the gipsy moth, and although a variety of American parasites are natural enemies, the aggregate effectiveness of all the species together is wholly insignificant. It is possible, however, that the caterpillars may be attacked by parasites, the larvae of which may be rendered unable to complete their transformations under the conditions in which they find themselves.

Since insects like the gipsy moth and the brown-tail moth are subjected to the



An Apparatus Similar to an Ordinary Show-Case, the Glass Sides Being Supplanted by Cloth in Which Sleeves Are Set Through Which the Nests May Be Handled Without Any Danger

attack of different species of parasites at different stages in their development, it has been necessary, in order to secure all of these, to import the host insects in as many different stages as possible and practicable. Importations of large caterpillars, ready or nearly ready to pupate (go into a sleeping state) were first made in 1905. It was demonstrated during that year that they could be brought to America with a fair degree of success and that at least a proportion of the parasites with which they were infested could be reared.

One of the greatest difficulties, experienced from the outset, has been the acclimatization of the parasites. The ones thus far cultivated have a tendency toward rapid dispersion over a wide area, thus hindering colonization. Even though a large number of individuals are released, their spread is so rapid that the possibility of meeting and mating is soon lost.

Perhaps the most serious handicap to the progress of the work is the preservation of the health of the assistants in the laboratory. The irritating and poisonous hairs of the brown-tail larvae, of which the nests are full, penetrate the skin of the assistants, entering their eyes and throats and almost filling the atmosphere of the laboratory. It was soon found necessary to keep the rooms thoroughly closed. Double windows were used, and the doors, too, were doubled, in order that a possible secondary parasite, if accidentally liberated, should have no chance of escape. This made the rooms very warm and increased the irritating effect of the larval hairs. Spectacles, gloves, masks, and even headpieces were invented, but they only increased the heat and were not entirely effective in keeping out the troublesome hairs.

Dr. Fiske finally devised an apparatus similar to an ordinary show case, the glass in one side being replaced by cloth with armholes, through which the gloved hands of the worker could be thrust and the brown-tail nests handled in full sight through the top glass. Much of the rearing of brown-tail larvae must be carried on under conditions in which such cases cannot be used, and so the old difficulty still exists.

It is hoped that the parasites already introduced will in time prove sufficient for the purpose intended. Only events themselves can be depended upon to answer this question. Unfortunately the moths continue to disperse and multiply in the meantime.

Spectacles, Gloves and Masks Are Worn by the Laboratory Workers as a Safeguard Against the Irritating Effect of the Gypsy Moth's Hairs

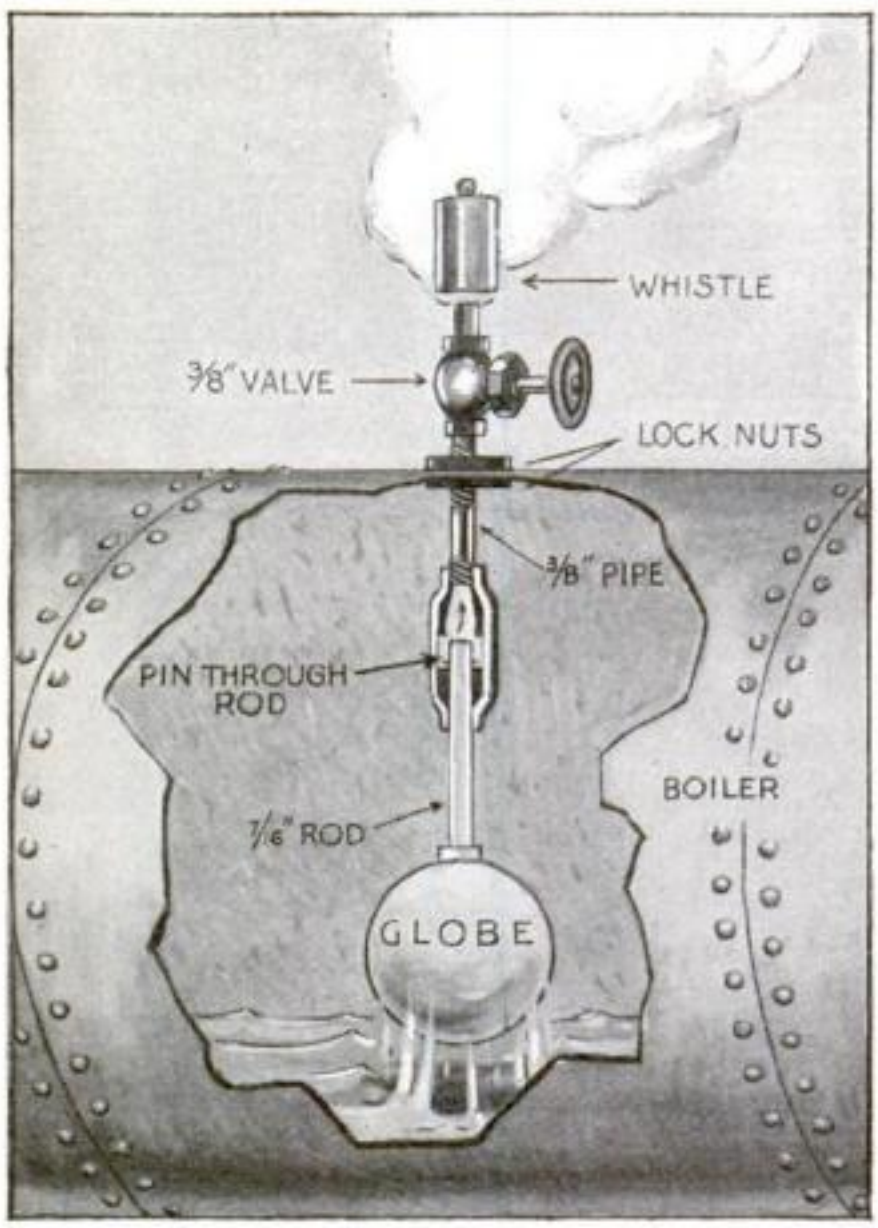
Why Whiskers Continue to Be in Style for Cats

ALTHOUGH hirsute adornments of all kinds, whiskers included, were once the real and indispensable thing, modern sanitary practice has made such inroads on unharvested beards and long hair that only a few scattered humans such as musicians and soap-box orators still retain their hairy luxuriance. Notwithstanding this, however, the house cat has grown and nurtured its crop of whiskers or feelers for the last million years or so without bothering about hygiene.

The fact is that the cat's whiskers are absolutely necessary to it. The whiskers are as long as the cat's head is wide, and the head is as wide as the body, so wherever the whiskers go there may the cat go also.

The tiny, delicate hairs grow from a gland and are nerved to the utmost sensibility. No matter how light the touch of the hair against an obstacle it is instantly felt by the cat.

A Low Water Alarm for Boilers, Which Has No Stuffing Boxes



When the Water in the Boiler Falls Below a Safe Level the Whistle Will Blow

THE low water alarm for steam boilers shown in the illustration has no packing boxes, the principal objection to home-made alarms.

A whistle is connected with a 3/8-in. globe valve. From the valve a piece of 3/8-in. iron pipe leads down. Locknuts hold the iron pipe and the boiler shell together at the top of the boiler.

To one end of a piece of rod 7/16-in. in diameter and 4 ins. long, a washer is attached and to the other end a ball (globe) float. The 3/8-in. pipe and the 7/16-in. rod are held together by a 3/8-in. check valve, which is turned upside down and the movable interior disk is then removed. A pin is passed through the rod within the valve. This pin can be easily placed, as all upright checks unscrew to permit access to the inside.

Perhaps it would be a safer plan to omit attaching the globe valve as it might be closed accidentally or deliberately, by a careless attendent. When the water falls below a safe level the whistle will blow.—James E. Noble.

Locomotive Runs Three Hours on Charge from Boiler Plant

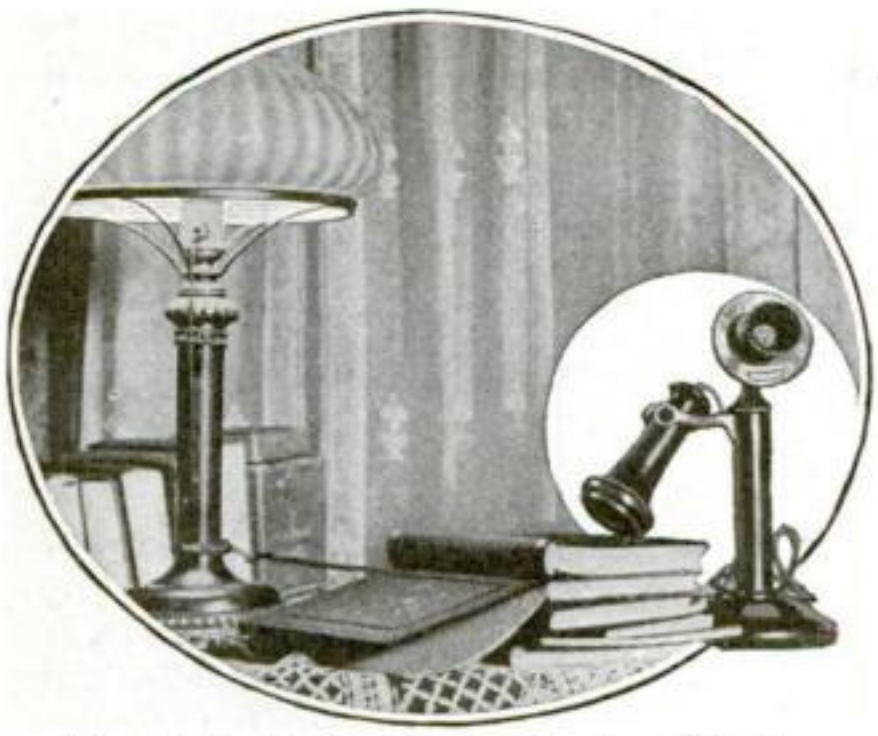
A FIRELESS steam locomotive is used for switching cars and tie trams at an Ohio manufacturing plant. The locomotive is of a type which was developed in Europe some years ago and is used around distillation plants, where cinders and live ashes would constitute a fire danger. It is operated by steam, the boiler being charged about seven times every twenty-four hours at the main boiler, at one hundred and fifty pounds pressure. The maintenance cost is very low. The tractive power is fully equal to that of the usual type, and although it weighs only twenty-two tons it has pulled as many as twelve loaded gondola cars at a time.

A "Soap" Which Is Not Used for Cleansing

FORTY miles removed from the familiar grease product marketed as different varieties of soap is the "grease-ball" shown in the accompanying illustration. It was formed in a boiler as a deposit resulting from the precipitation of the carbonates of lime and magnesia in the feed water. When feed water enters a hot boiler the carbonates of lime and magnesia that the feed contains are precipitated from solution and if the circulation in the boiler is not too active the precipitated matter often floats on or near the surface for a time in light particles. When the floating carbonates unite with the organic parts of any oil that may be in the boiler the soap is formed.

This "Grease Ball" Was a Sticky, Insoluble Feed Water Deposit Formed in a Boiler

Why You Could Not Get Your Man on the Wire



The Books in the Illustration Are Holding the Receiver Off the Hook, Indicating to "Central" That the Line Is Still Busy

IT is a generally conceded fact that the telephone operator at "Central" is a very necessary evil designed to teach us patience; but a study of the accompanying illustration from a photograph by Val. B. Mintun, of Kansas City, Mo., may avert a few anathemas from her unsuspecting head. The picture tells its own story most effectively. It may not be invariably the reason why you cannot get in touch with the party you desire to reach by telephone, but it very often happens that carelessness in hanging up the receiver leaves the circuit still closed, as it is when the telephone is in use, indicating to Central that the line is busy. The receiver must suspend its full weight from the hook in order to leave the line open.

A Typewriter Made Especially for the One-Armed

IN all of the belligerent countries the effort is being made to find ways and devise means by which the war-cripples may be able to support themselves when once more well. A German has invented a typewriter that can be worked with one hand and one foot. Nor is a perfect hand required, for the writing is done by moving a lever to left and right and the only other hand-movement demanded is the grasping of the paper for insertion. The typewriter has no keyboard and the characters are on a type-cylinder. A number of the ordinary movements of a typewriter are produced by pedals worked by the foot. Thus the paper is introduced by means of the hand and foot, and the spacing of the words is controlled by the foot, the moving upwards of the paper after a line is written is caused by the foot, and the shifting of the type-cylinder for capitals, small letters, or figures is also done by foot.

Catering to the Feminine Patrons of the Bootblack

AN adjustable wooden apron or tray hinged to the seat of a shoe-shining chair is a new idea which will appeal to the feminine patrons of the bootblack. It may be swung from a depending position to a raised position in which it supports the skirts of the woman who is having her shoes shined and serves as a rest for the limbs as well. It also prevents the skirt from being soiled while the polishing is in progress.

The Wooden Tray Is Adjusted by a Slight Movement and Serves as a Rest for the Legs and a Protection to the Skirts

Housekeeping Made Easy

This Obliging Little Dachshund Holds on His Back an Iron Scraper for Removing Mud and Dirt from Shoes. He Lifts His Task from the Menial to the Decorative

Abundant Heated Air Well Distributed Is Obtained from This Portable Air Blower Which will be Found a Great Convenience in the Home for Between-Season's Weather, and Also in Cleaning and Dyeing Establishments, Tonsorial Parlors, etc. Three Temperatures Are Assured

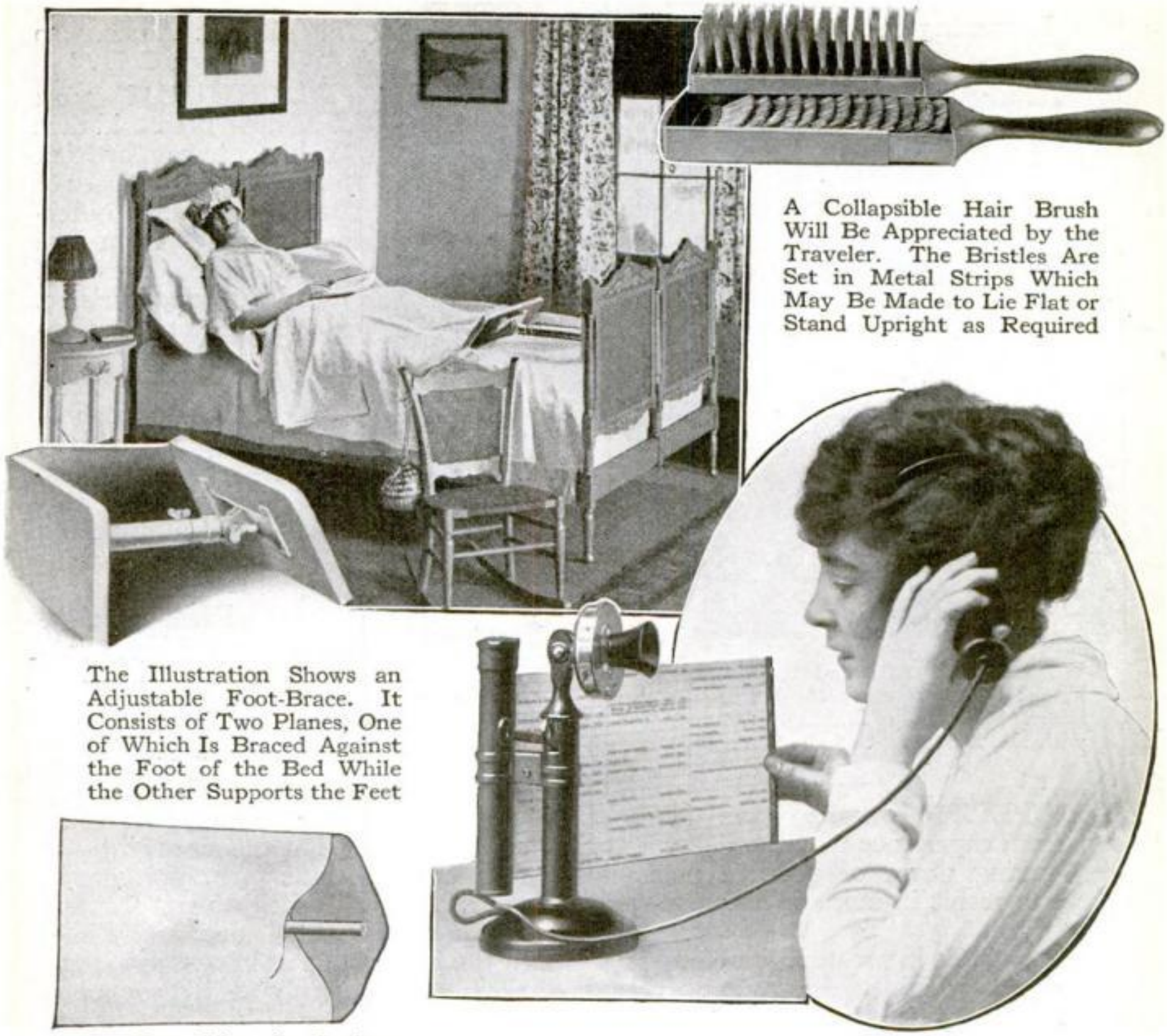
The Latest Convenience for the Busy Man's Telephone. It Is a Coil of Heavy Insulated Metal as a Rest for the Hand Holding the Receiver

This Useful Household Tool May Be Used as a Hammer, a Hatchet, Wire Cutter, Tack Puller, Screw-Driver, or Pipe Wrench. The Tool Is 6½ Inches Long, and Not Heavy

On the Right Is Shown Two Pieces of Sponge Attached to Folding Frames with Small Pieces of Soap in the Center, Which Is the Most Recent Departure from the Soap-Box Being Also Used as a Sponge

A Pan Greaser That Consists of Lamp Wicking Fastened Into a Nickeled Handle Is a Sanitary Device for Greasing and Oiling Pans, as the Hands Do Not Touch the Pan At All. The Wicking May Be Washed and Renewed Whenever Desired

Housekeeping Made Easy



A Collapsible Hair Brush Will Be Appreciated by the Traveler. The Bristles Are Set in Metal Strips Which May Be Made to Lie Flat or Stand Upright as Required

The Illustration Shows an Adjustable Foot-Brace. It Consists of Two Planes, One of Which Is Braced Against the Foot of the Bed While the Other Supports the Feet

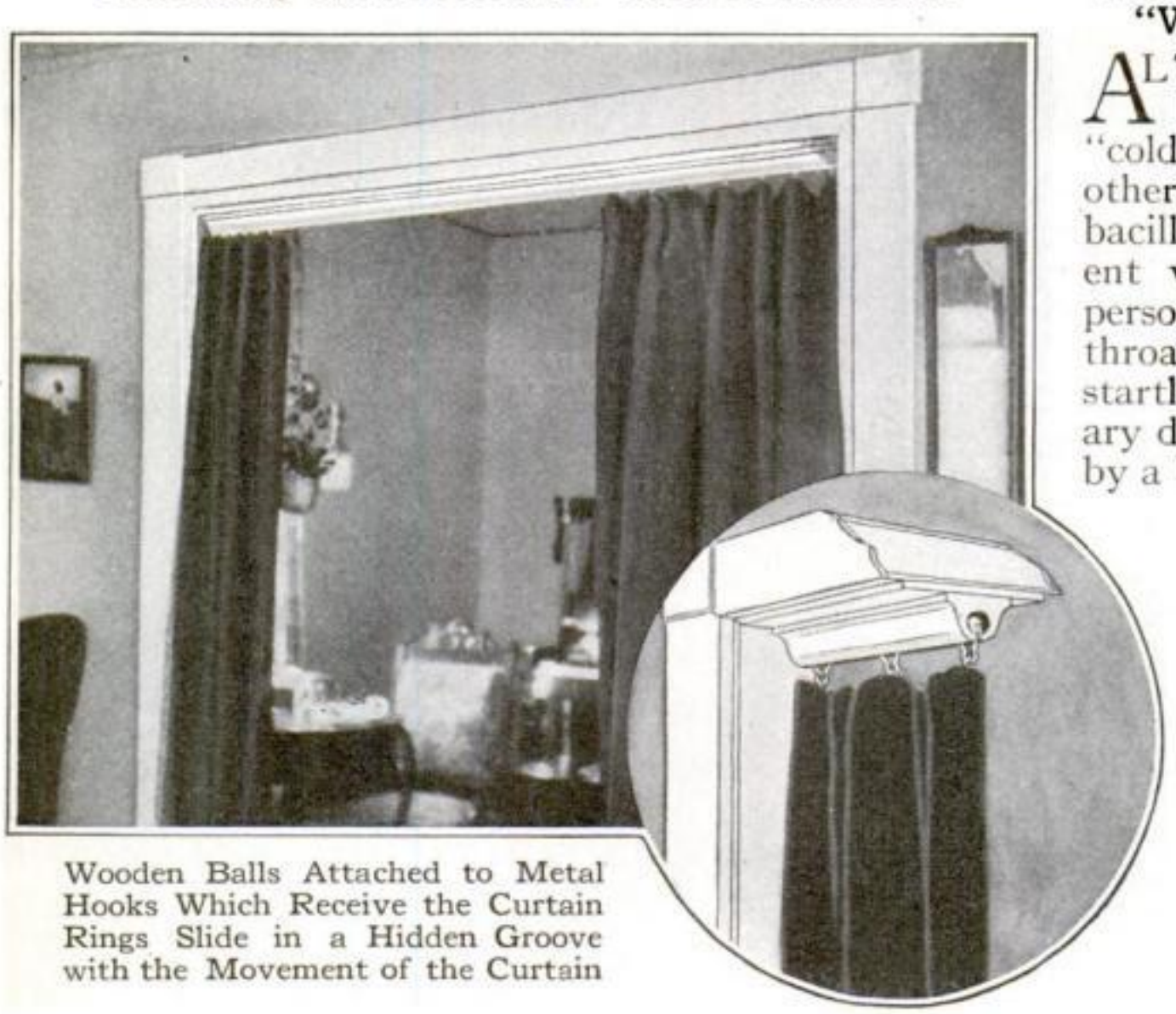
A New Idea in Sanitary Paper Drinking Cups Provides a Straw as an Added Convenience. Each Cup Is Wrapped in a Separate Case

A Telephone Index Which Works on the Principle of a Roller Shade Has Been Put on the Market by a Boston Manufacturer. It Consists of a Coiled Spring in a Tubular Metal Case, Which is Clamped to the Pedestal of a Desk Telephone, and a Roll of Paper Ruled Off Most Conveniently

A Chicago Firm Is Placing on the Market Articles Coated with a Phosphorescent Substance. Match-Boxes, Key-Holes, Clock Faces and Electric Switches Are Treated. If Submitted to Light During the Day They Will Shine All Night

The Ice Pick Illustrated Below Is Made of Separable Parts. The Handle Is Provided with Jaws Which Clamp Tightly or Release the Three Removable Picks

Increasing the Decorative Value of Portieres



Wooden Balls Attached to Metal Hooks Which Receive the Curtain Rings Slide in a Hidden Groove with the Movement of the Curtain

PROPERTY owners have learned from experience that the putting up and taking down of portiere poles is likely to result in more or less damaged woodwork.

They will be interested, therefore, in a new device which does away with these poles entirely, but without dispensing with portieres or curtains. In fact, the design increases the decorative value of the portieres.

This device looks like a moulding, but there is a large opening through the center and a slit in the bottom. Wooden balls slide back and forth inside the moulding, and metal rings attached to them extend through the slit to receive the hooks fastened to the curtains. The moulding is put up and made a permanent part of the standing finish, being painted or stained in any color or finish desired. Once in place, any set of curtains may be attached and removed at will and in a moment of time without injuring the woodwork.

The moulding is fastened to the top of the door opening, of course, and if the curtains or portieres are pinned high enough, there will be practically no space for drafts to enter.

The Latest Answer to "What Is a Cold?"

ALTHOUGH you have been told that "colds" are caught from others by the transfer of bacilli of several different varieties from one person's nose, eyes and throat to another's, a startling and revolutionary discovery just made by a U. S. Army Officer, Dr. George B. Foster, Captain in the Medical Corps, shows that this medical teaching is almost certainly wrong.

From his elaborate experiments and unexpected results, it appears that common colds are caused by a virus, present in the tears and nasal fluids of those affected, so small that the most powerful ultra-microscope fails to bring them to view. They will easily pass through porcelain filters, which successfully hold back the bacteria of all known infectious diseases, except such as hydrophobia, measles, foot and mouth disease, infantile paralysis, and yellow fever. These, too,. are ultra-microscopic.

While the precise type of ultra-microbe present in the virus of running noses, sneezes, and tears has not yet been identified, experiments thus far prove that the porcelain-filtered product will produce colds in healthy people, and that the mucus taken from the nose of those who suffer with colds, and weakened with water 90,000 times, still retains this living virus.

Tests of this fluid were made on eleven physically sound soldiers and five drops of it were squeezed into each nostril of each of the men.

The discovery followed that colds could develop from eight hours to two days after exposure to the infection. All of the men "caught cold" within this period, though some threw off the effects of the cold virus within a few hours.

Shoes of Esparto Straw Which Outwear Leather

A Pair of These Esparto Fiber Shoes Have Been Known to Outwear a Dozen Pairs of the Ordinary Tanned-Hide Soles

ESPARTO shoes, or shoes made of the toughest and strongest of the coarse fibers, are still worn in Iberia and in some parts of Spain and Portugal. There is no shoe made which will outlast them, not excepting leather shoes. One pair of Esparto shoes has been known to outwear about a dozen tanned hide soles. This is due to their faculty of picking up and retaining in their interstices stony or gritty particles which wear like nails.

As the shoes are worn they constantly pick up and retain these foreign particles, and as fast as these are worn out they are replaced automatically by others, providing the wearer of the shoes continues his walking. Thus a self-soling process is constantly going on.

It is not uncommon in some parts of Spain or Portugal to hear the natives boast of wearing a pair of Esparto shoes for twenty-five years or more. The soles will survive an aggregate exceeding six thousand miles of walking without wearing away appreciably.

Several years ago an attempt was made by a concern in this country to manufacture the shoes in quantities large enough to supply the demand from abroad. A plant was built, people were engaged, contracts for the delivery of the fiber were closed and the manufacturing was begun. This did not continue for long, however, for it developed that the company was obtaining an inferior grade of coarse fiber with the result that their shoes were not wearing well. Accordingly the company went into bankruptcy, with a net loss, it is said, running well into five hundred thousand dollars. At the present time genuine Esparto shoes are to be obtained only in the foreign sections of some of our large cities.

The Esparto fiber is also largely used in the European paper industry under the name of Esparto grass. It makes a paper of excellent durability, but American paper makers have not used it. It requires expert knowledge in its treatment. Esparto shoes are largely made and worn in the rural districts of France.

For a comfortable shoe for all-round wear the Esparto shoe has no peer. Those who have worn them never put them aside for leather shoes. At first the shoes are very soft, simulating velvet, but after they have been worn for a short time they become as solid and hard as leather.

Using the Waste Heat of a Kerosene Lamp

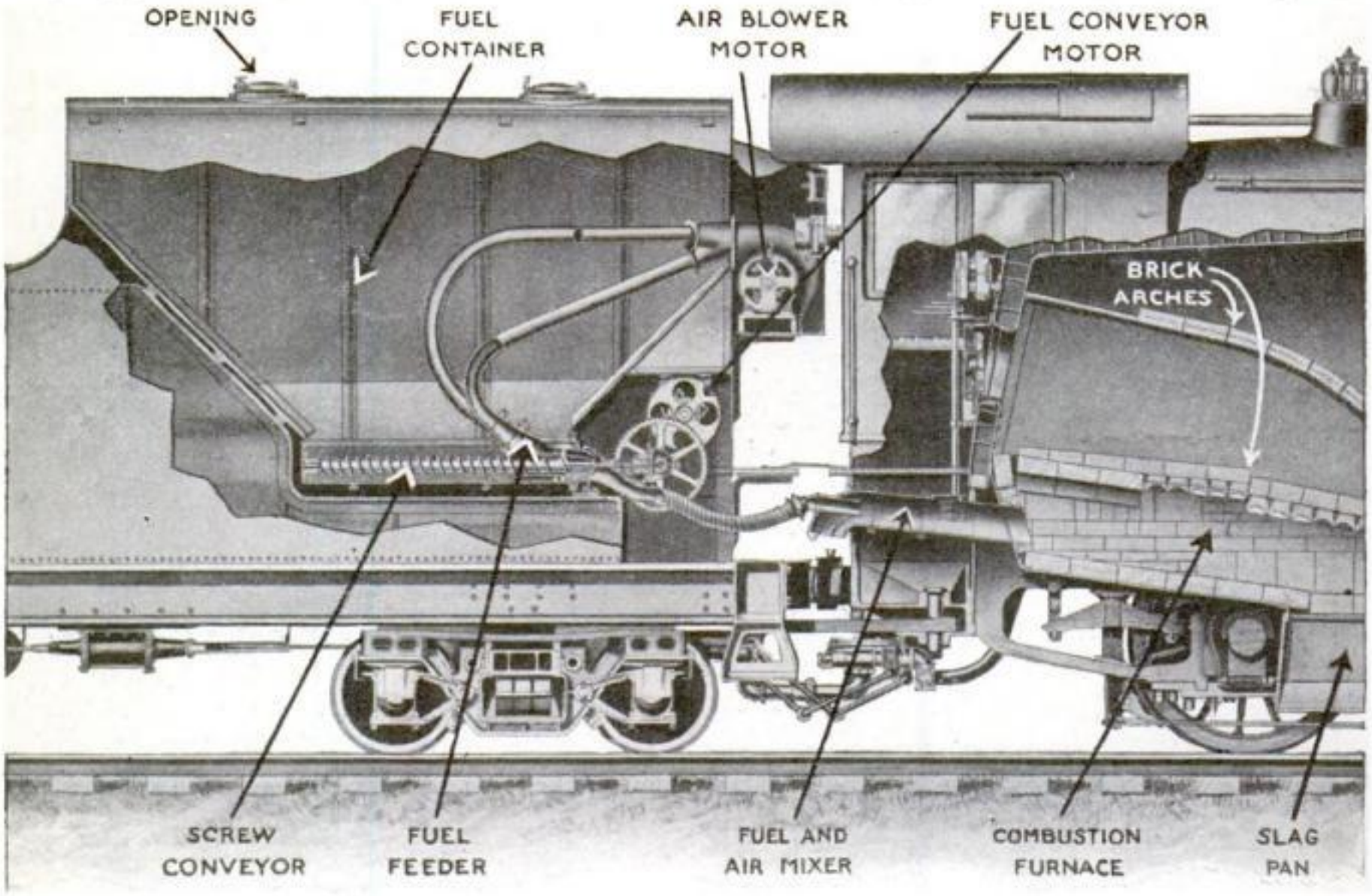
THIS illustration shows how the waste heat from an oil lamp is utilized every night to heat a kettle of water in an English engine-room.

The photograph was taken in the engine-room attached to Platte Fougère lighthouse, Guernsey, England.

The Engineer Who Utilized the Heat from the Oil Lamp Is No More Resourceful Than the Engineer Who Heats His Coffee on the Radiator

A Locomotive That Burns Pulverized Coal

OUR modern locomotives are voracious creatures. To fire one of them — the Twentieth Century Limited, for instance—is a task gradually approaching the superhuman. The only remedy, according to railroad men themselves, lies in the utilization of pulverized coal. Of only comparatively recent date, however, have appliances for burning powdered fuel or coal-dust in locomotive fire-boxes been effectively developed. The results have been entirely satisfactory, effecting a saving of from fifteen to twenty-five per cent of fuel and untold labor.



The Fuel Container, Which Is a Part of the Ordinary Locomotive Tender, Receives the Coal Dust or Pulverized Coal Through Two Openings in the Top. The Fire-Box Is Provided with Brick Arches and Air Inlets. A Slag Pan Is Used Instead of the Usual Ash Pan

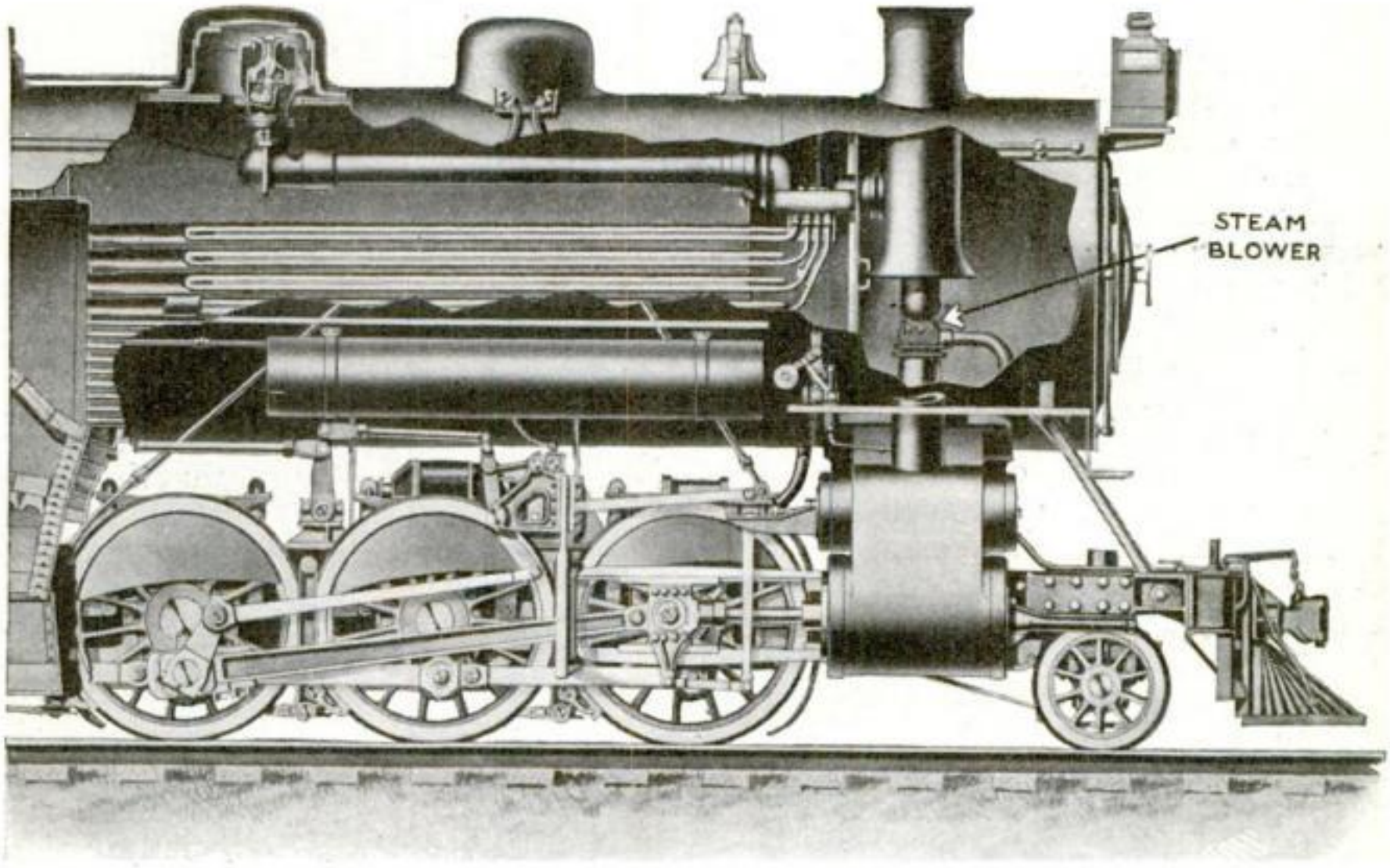
This economy is possible because any solid fuel which in a dry, pulverized state has two thirds of its content combustible will be suitable for steam-generating purposes. This means that such ordinary coal products as dust, sweepings, culm, screenings and slack, and even lignite and peat, are as productive of economic results as the larger and better grades of coal. Some of the products mentioned are unsalable and have been thrown away as waste, so the great saving effected is apparent. The total cost to prepare pulverized coal is something less than twenty-five cents a ton, and the preparation is not at all complicated. The coal must be dry and ground to a fineness so that it will pass through a one-hundred or two-hundred mesh screen. This is all the preparation necessary.

There are three railroad lines which have locomotives fitted with a successful apparatus to burn coal-dust. These are the New York Central, the Chicago and Northwestern and the Delaware and Hudson. The last-named system has probably the largest pulverized fuel-burning locomotive. Its tractive effort is about sixty-three thousand pounds.

In the accompanying illustration is shown the pulverized fuel-burning equipment as applied to a locomotive. The fuel container, which is a part of the ordinary locomotive tender, receives the coal-dust or pulverized coal through two openings in the top. As dryness of the fuel is a prime requisite these openings are kept tightly closed. In starting the fire the fireman turns on the steam-blower in the smoke-box, after which he places a piece of lighted oil-waste in the furnace. Immediately following this he starts the air-blower motor and the fuel-conveyor motor. The screw-conveyor forces the fuel into the fuel feeder, where it meets the air driven by the blower. The fuel and air are then driven through a commingler, and this mixture then enters the combustion furnace, which is the ordinary locomotive fire-box fitted with a fire-brick floor in place of grate bars, where the lighted oil-waste ignites it. The fire-box is provided with brick arches and air inlets. There is a slag pan instead of the usual ash pan.

The regulating mechanism controlling air and fuel is within reach of the fireman, so he need never have occasion to leave his place in the cab near the engineer.

When the powdered coal and air are mixed in the right proportions, the mixture bursts into a clear, intense flame in the fire-box, with no visible smoke at the stack. It takes less than an hour to get up two hundred pounds of steam, and when the engine is standing the fire may be put out entirely and then reignited within an hour from the heat of the brick arches in the fire-box.



In Starting the Fire the Fireman Turns on the Steam-Blower in the Smoke-Box. The Air-Blower Motor and the Fuel-Conveyor Motor Are Then Started and Fuel and Air Enter the Combustion Furnace Which Is an Ordinary Locomotive Fire-Box with a Fire-Brick Floor

The Wastage of Flying Machines In the Great War

THE English aeronautic periodicals publish fairly complete lists of casualties sustained by the flying squadrons of the Allies as well as by those of the Germans. In a single month on the western front, the British brought down sixteen German aeroplanes, the French thirty. The British losses, on the other hand, were ten, and the French twenty-eight. If machines are shot down with such ease on both sides, the wastage of aeroplanes in this war must be enormous. No wonder that thousands of men are employed in the aeroplane factories of all the warring countries to make up the losses.

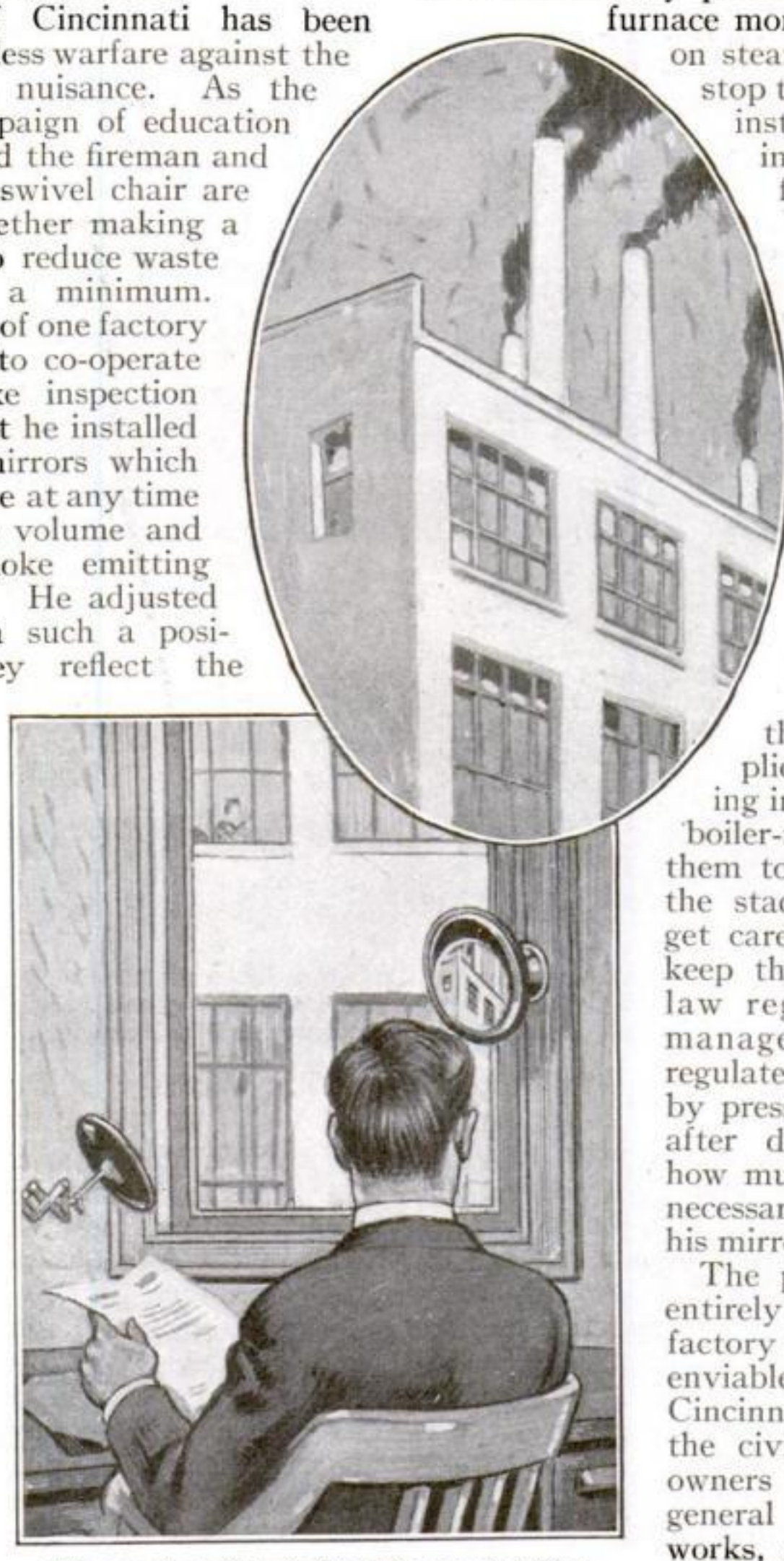
Keeping Watch on the Chimney

TO-DAY power-plant owners in Cincinnati are as proud of the clean condition of their stacks as they are of their clean engine and boiler-rooms and general interiors.

The city of Cincinnati has been waging a relentless warfare against the factory smoke nuisance. As the result of a campaign of education the engineer and the fireman and the boss in his swivel chair are all working together making a superb effort to reduce waste by smoke to a minimum.

The manager of one factory was so anxious to co-operate with the smoke inspection department that he installed in his office mirrors which enable him to see at any time of the day the volume and density of smoke emitting from his stack. He adjusted two mirrors in such a position that they reflect the top of the smoke stack so that they are easily seen from his desk, several feet from the window. When the mirrors divulge a smoking stack he compares the smoke density with a smoke chart tacked to the window frame beside the upper mirror. When the smoke is equal to or greater in density than "Number 3" on the chart he presses a button on his desk which "blows" an automobile horn which is located in the engine room.

This serves to "wake up" the fireman, who immediately proceeds to give the furnace more air, and turns on steam-air jets which stop the smoke almost instantly, by burning the rich gases from the fuel bed which would otherwise go to waste. The manager continues to operate the button on his desk until the faithful mirrors report that the smoke is reduced to below the objectionable density.

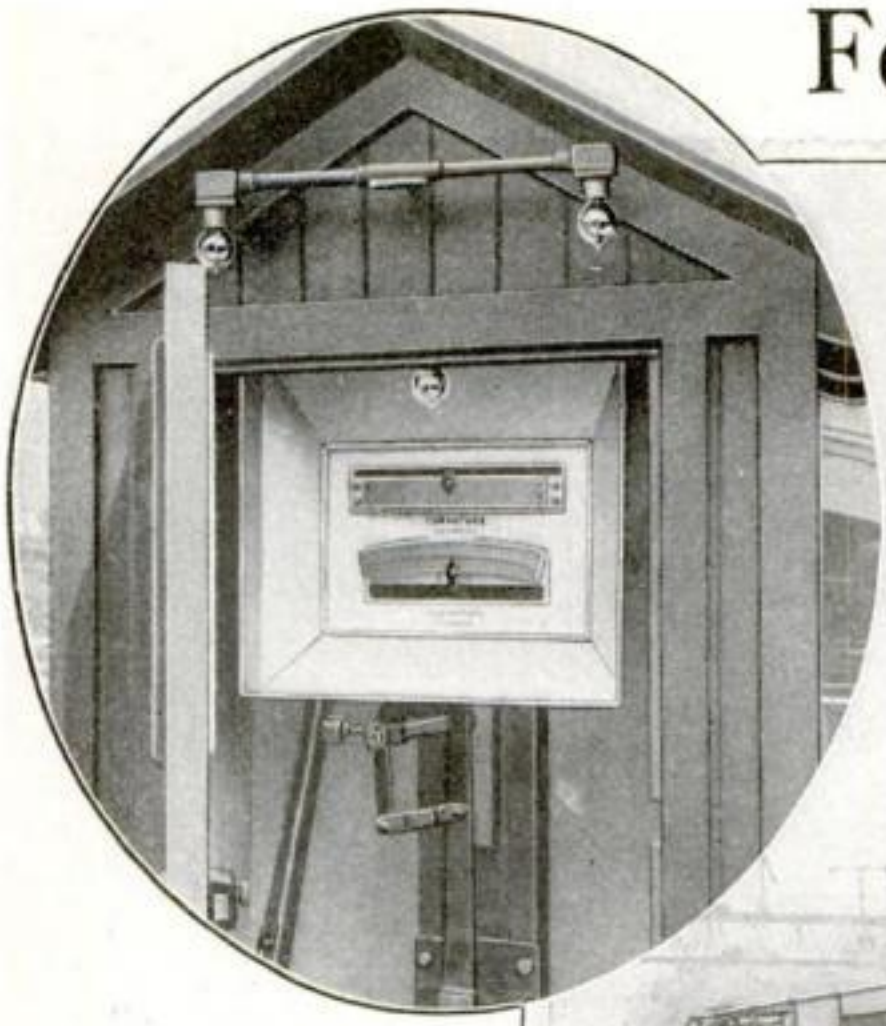


Mirrors Installed in the Manager's Office Are So Adjusted as to Enable Him to See the Smoke Stacks and Gage the Density of the Smoke from a Chart Hung Nearby

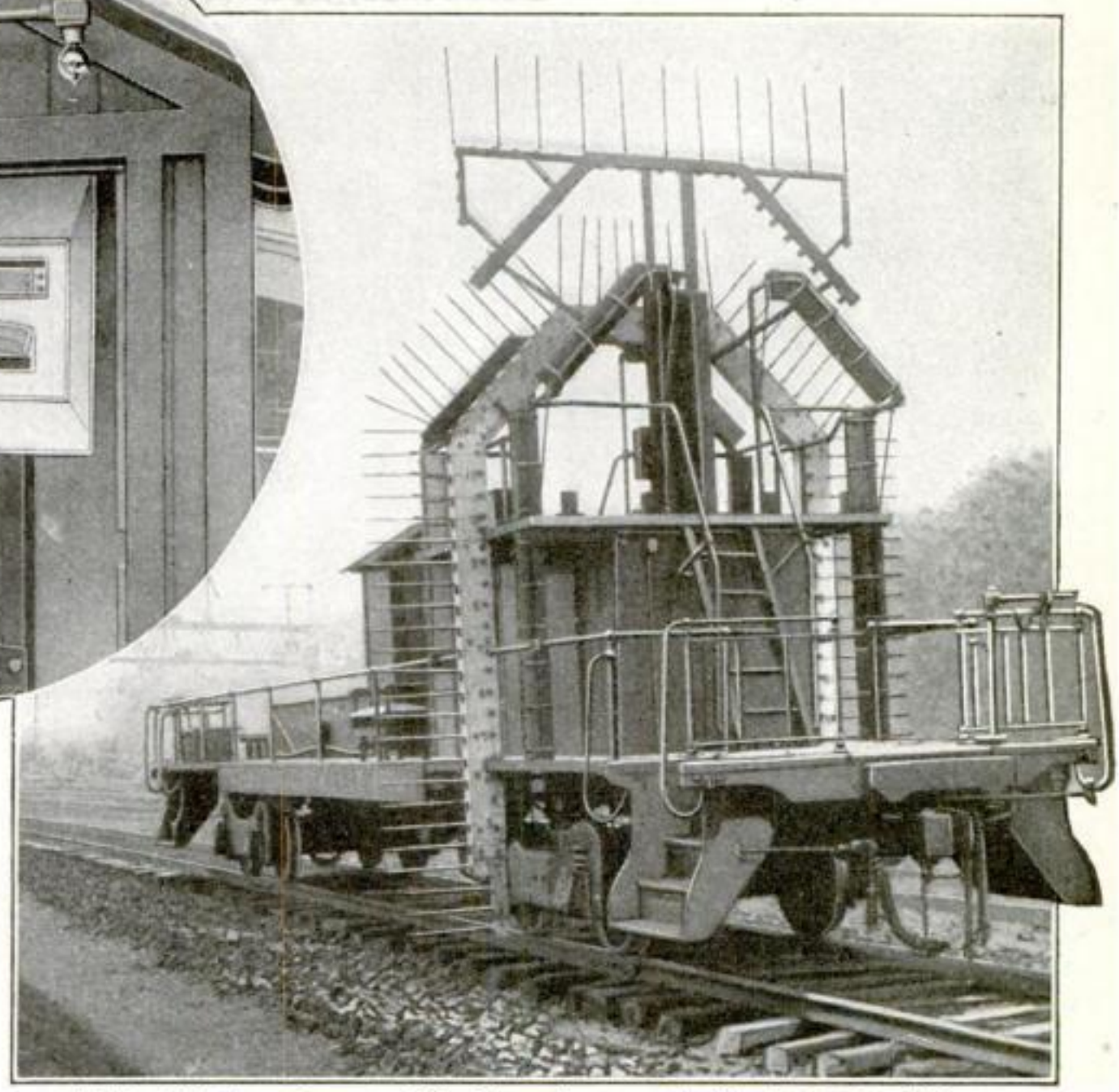
The firemen in this plant are supplied with an opening in the roof of the boiler-room to enable them to see the top of the stack, and if they get careless and fail to keep the smoke within law regulations, the manager proceeds to regulate things himself by pressing the button, after determining just how much regulating is necessary by looking in his mirrors.

The plan has proved entirely feasible and the factory no doubt has an enviable reputation in Cincinnati, not only for the civic pride of the owners but also for the general efficiency of the works, as indicated by the alertness and comprehensive oversight of its manager.

Feeling the Way



An Attachment on the Rear Truck Indicates on a Scale Inside a Cabinet in the Car the Degree of Curvature and the Elevation of One Rail Over the Other



With All Attachments Working Automatically It Is Possible to Take Clearance Measurements While the Car Is Running

A NEW clearance car has just been placed in service on the Pennsylvania Railroad lines east of Pittsburgh and Erie. It is being run over every division as rapidly as possible in order to secure correct measurements of the distances from the track to projecting portions of station buildings, tunnels, bridges and other objects. It is also designed to indicate automatically while moving on curves the elevation of the rails and the degree of curvature.

The car is built entirely of steel, and is equipped with air-brakes, steam fittings and electric lights. There are two floors, or elevations, both of them used for taking measurements from the templets. Clearances are computed from the center of the wheel truck, over which the main templet is erected. From an elevation of twelve feet above the top of the rails the templet tapers up toward the middle of the car at an angle of forty-five degrees.

Immediately in front of the templet is an auxiliary templet designed to measure overhead bridges, tunnels and other objects between elevations seventeen and twenty feet above the top of the rails. This templet is capable of being raised to a height of eighteen feet by a crank and a ratchet arrangement on the floor of the car. Enclosed in steel cylindrical boxes with translucent glass fronts facing the templets is a series of electric lights which extend from the floor of the car on each side to a height of fifteen feet. Light from these makes it possible to take measurements both day and night.

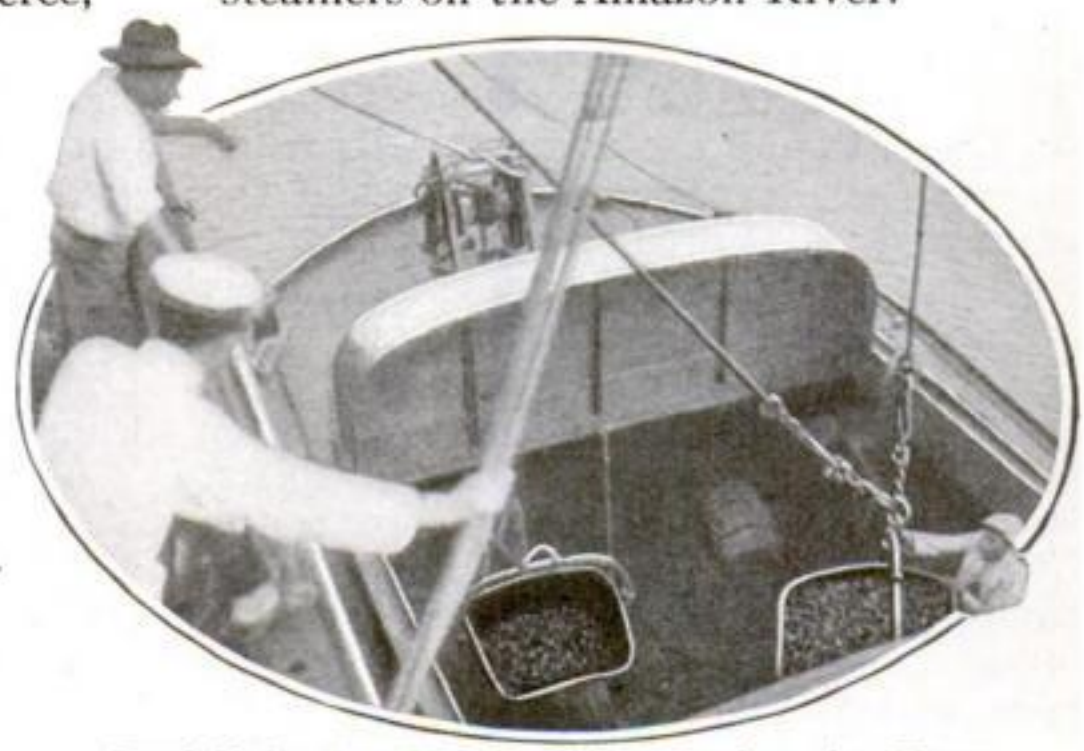
Attached to the feelers and the side of the templet are graduated scales which indicate automatically the distance from the rim of the templet to a side or overhead object. In addition, a small board equipped with a set of feelers spaced one inch apart has been provided to measure cornices of roofs, of shelter sheds, or other irregular objects.

The Sensitive Brazil Nut

The Nuts Are Stored on Board River Lighters to the Nearest Port of Call for Ocean Steamers. They Are Turned Over with Shovels Each Day and Ventilators Keep a Current of Air Circulating Below Decks

A POD with a diameter of from five to six inches, in a thick, hard woody outer covering, contains the so-called Brazil nut of commerce, from twenty to twenty-four of these seeds being closely packed in one shell. On board the vessels the greatest care is taken of the nuts. They are turned over daily and kept supplied with a constant current of fresh air. Twenty-four hours of stormy weather in which the ventilators have to be closed is sufficient to ruin an entire cargo. Every precaution is taken to keep the atmosphere "comfortable," for the sensitive nut feels the slightest change of temperature.

As they begin to ripen the pods fall and are gathered by the natives, who, cutting the outer shell with a machete, collect the nuts and carry them in baskets to the rivers on which they are transported by canoe, launch, or river steamers, to the nearest port of call for ocean steamers on the Amazon River.



Steel Tubs Are Used in Transferring the Nuts to the Ocean-Going Steamers from the Lighters as an Extra Precaution Against Dampness

Tethering the Largest of the Super-Dreadnoughts

THE illustration represents the largest anchor ever made. It weighs twenty thousand pounds.

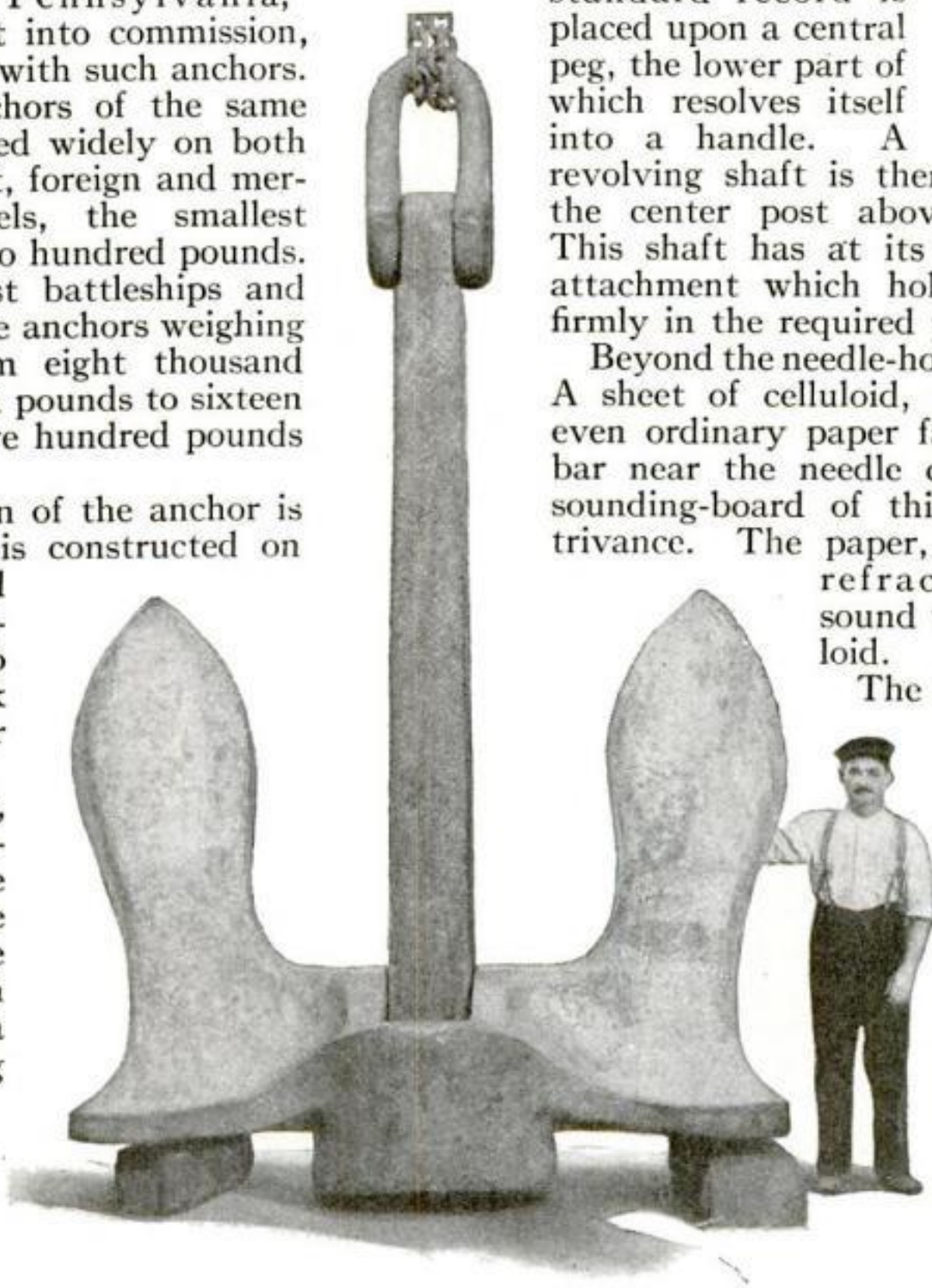
It is made of cast steel; that is, a liquid steel poured in a mold of sand, made from a pattern of wood similar in shape to the anchor itself. The anchor which had the distinction of being the largest in the world previous to the manufacture of the one illustrated here, was one weighing eighteen thousand five hundred pounds.

The principal use to which this size anchor is put is for anchoring the largest super-dreadnoughts which the United States Navy is now building. The great battleship or super-dreadnought "Pennsylvania," recently put into commission, is equipped with such anchors. Smaller anchors of the same type are used widely on both Government, foreign and merchant vessels, the smallest weighing two hundred pounds. The smallest battleships and cruisers have anchors weighing usually from eight thousand five hundred pounds to sixteen thousand five hundred pounds each.

The design of the anchor is simple. It is constructed on the ball and socket principle with no pins to break or bend or drop out.

The fluke, or main portion, is in one solid piece and the shank has an end like a ball working in a socket.

Many anchors are hinged on a pin which rusts out and fails to hold.



The Anchor Is Constructed on the Principle of a Ball and Socket, with the Fluke or Main Portion in One Piece

A Hand-Made Hand-Played Phonograph

AKANSAS CITY man has invented a "phonograph" which is operated by hand and which may be built at a cost of ten or fifteen cents. On this odd instrument, any standard record is placed upon a central peg, the lower part of which resolves itself into a handle. A revolving shaft is then placed upon the center post above the record. This shaft has at its outer end an attachment which holds the needle firmly in the required position.

A Phonograph Which Requires No Expensive Cabinet. It Will Play Any of the Standard Records

Beyond the needle-holder is a weight. A sheet of celluloid, parchment, or even ordinary paper fastened to the bar near the needle constitutes the sounding-board of this unique contrivance. The paper, however, will refract a thinner sound than will celluloid.

The "phonograph" is operated by a twist of the wrist. The weight at the outer end of the revolving shaft insures its circular motion and the needle, following the grooves in the record, spirals its way toward the center of the record.

Your Meerschaum Pipe

By Felix J. Koch

Pipes in Various Stages of Construction. Cutting the Meerschaum Is the First Step. Then a Hole Is Drilled in the Embryo Pipe-Head Into Which the Future Bowl of the Pipe—a Plug Worked Up on a Nearby Lathe—Must Fit. When the Pipe Is Mounted On This Part the Shaping Process Is Commenced

MEERSCHAUM pipe-making is one of the most interesting processes of the American mid-west. In normal times, the meerschaum comes from abroad. Just now, that export has stopped, and the pipe-makers of Cincinnati get it from others at home—wherever it may be bought. It is shipped in white blocks, resembling ivory. But the substance is considerably whiter than the usual elephant-tusk is and very much lighter. In fact, the lightness of a given block of meerschaum is astonishing. Handled for American manufacturers largely through New York commission houses, most of the best meerschaum is brought from Turkey in Europe. It arrives in little chests, or *kasten*, within which each separate piece of the substance is found securely wrapped in cotton. Such meerschaum is paid for by the number of pieces. Curiously enough, the dealers prefer small pieces to large, since it takes an

expert cutter to know how to cut such with minimum amount of waste. Skilled meerschaum-cutters out of a job are not easy to find.

Cutting the meerschaum—the first step in pipe manufacture—is done with an ordinary saw. A good workman can cut the forms for perhaps two dozen pipes from the raw material in a single working-day. As cut, these rough forms are thrown into cold water to soak. In the water they are left until the supply desired is cut up and the man ready to go on with the pipes.

Rudely resembling the ultimate pipe, each form is taken in hand and a hole drilled into the pipe-head. Into this hole—the future "bowl" of the pipe—a plug, on a nearby lathe, must fit. With the embryo pipe mounted on this, "shaping" is begun.

Meerschaum pipes are shaped from the stem end on. Different men require varied types or forms of pipes; though the so-called "Bull Dog" shape and the blunter "Hungarian" pipe, and again, the egg-shaped bowl predominate. The base of the pipe is cut off by hand because it does not fit to the lathe.

That we of to-day should still find use for the rush of the wayside-brook is indeed interesting. For the next step in the process old-fashioned rushes are used—cut into slits and employed for polishing the pipes. Usually the rushes are moistened for such use. They impart a polish which, it appears, cannot be otherwise obtained.

Neatly shaped and polished, your meerschaum pipe must be subjected to still another process. The pipe is boiled in common bee's wax, because no piece of meerchaum in the raw state will "color" as smokers require.

After this boiling the pipes are permitted to cool. Then they are given another polishing—this time with cotton flannel sheets and prepared chalk. Even that does not suffice. There must still go to that pipe a final hand-polishing, done with alcohol.

From the time of starting a pipe until its completion, a half-day's steady labor of the most skilful workmen is required.

A Good Workman Can Cut the Forms of Perhaps Two Dozen Pipes from the Raw Material in a Single Working Day. These Forms Only Rudely Resemble the Ultimate Pipe shape

Pipes when finished are classed, according to the meerschaum of which they are made, into first and second grades. And prices for the simple pipe will run from $3.50 to $10, or even $15 at the factory.

Carved pipes, of course, will range to almost any price; twenty-five dollars is perhaps the least for which one can hope to get a fine pipe. Naturally, the price of the meerschaum has much to do with this.

Meerschaum is not, as so many suppose, a spoil of the sea; but is quarried or dug in Anatolia. The fair grades of the stone are found one hundred feet below ground. The deeper you dig the better is the product. The splendidly carved pipes, of which every pipe lover will have one or two, are almost always a deep mine product.

Good meerschaum pipes, if of the softer stone, should color in a year. Others may take two or three years. There is no better taste with the "colored" pipe; though enthusiastic smokers often delude themselves with the belief that there is.

With His Bow and Five-Foot Arrows the Guiana Native Can Shoot and Kill Fish Weighing from Ten to One Hundred Pounds After "Calling" Them Up

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The Floating Vegetable Gardens of Mexico

THE Lake of Xochimilco, near the city of Mexico, is nearly covered with floating gardens called chinampas, on which are cultivated vegetables and flowers for the city markets. They are formed of floating masses of water plants covered with soil and secured by poplar stakes. The latter take root and surround the islands with living hedges, which are useful as well as ornamental.

Fishing in Guiana with the Bow and Arrow

INSTEAD of using nets or the conventional hook and line, the natives of Guiana shoot the fish with bow and arrows. The arrow used is designed especially for this purpose and is about five feet in length, with no feathers. The head, which is barbed, is made from sheet iron and is provided with a socket which is slipped over the end of the shaft by a light, strong line about ten feet long.

When the fish is struck and the barbed point is buried in its flesh the cane shaft floats free and resting upon the surface of the water serves as a buoy to mark the catch, which is hauled in by means of the line attached to the head.

Fish weighing from ten to one hundred pounds are caught in this manner. When there are no fish visible or when they are too far beneath the surface to shoot with certainty the natives resort to "calling" the fish. This is accomplished by uttering a low whistling sound and waving the finger tips in a peculiar manner. Surprising as it may seem, the fish often approach the hunter within bow shot when thus called.

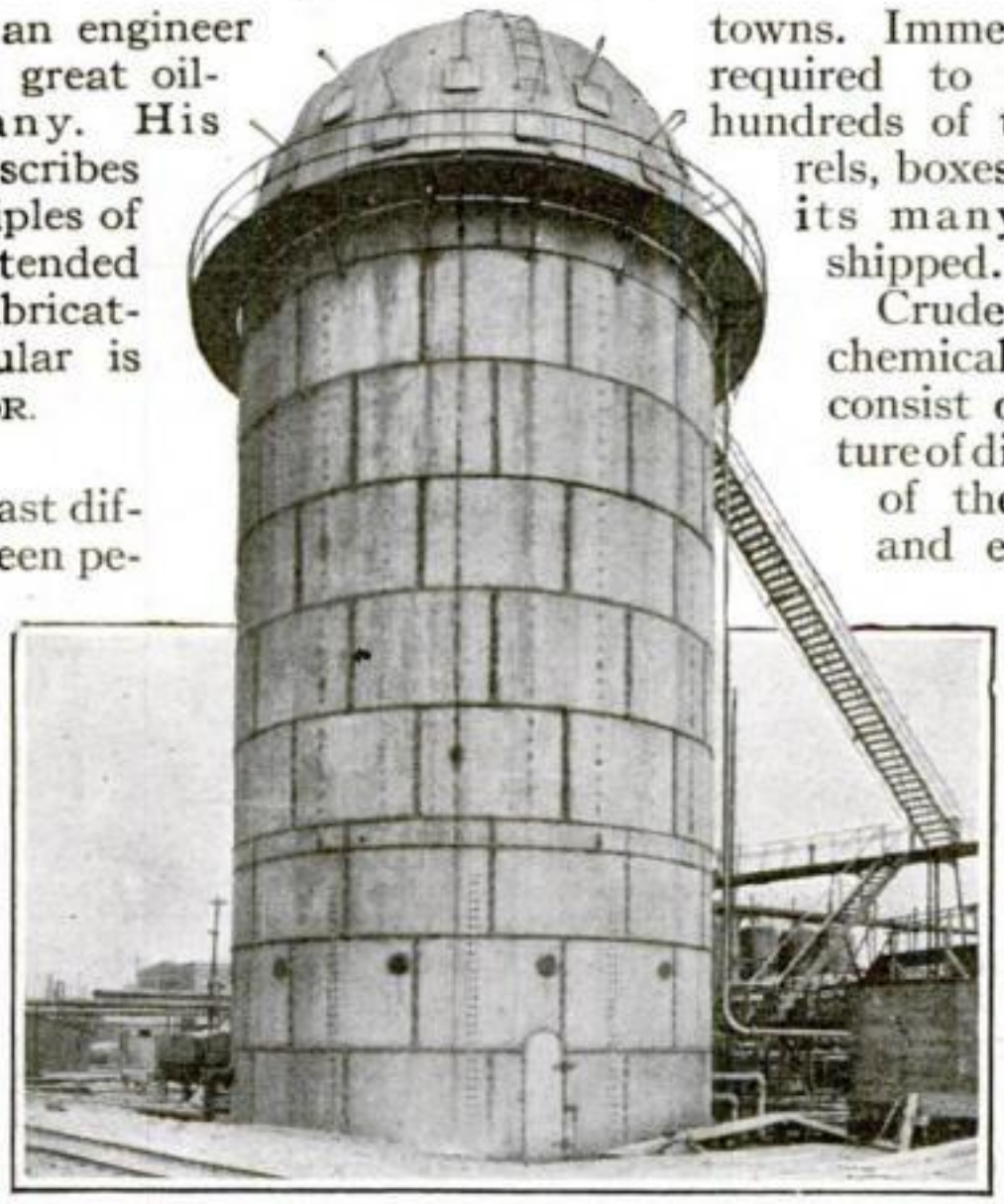
But one does not need to go to faraway Guiana to see fish killed by the bow and arrow. Our own Native American Indians are past masters of the trick, and a sojourn with them in one of the western reservations will convince the visitor that shooting fish is one of the Indian's favorite pastimes. An arrow much shorter than that used by the natives of Guiana is used, and no line is attached to the head of the arrow.

The Story of Petroleum

By C. W. Stratford

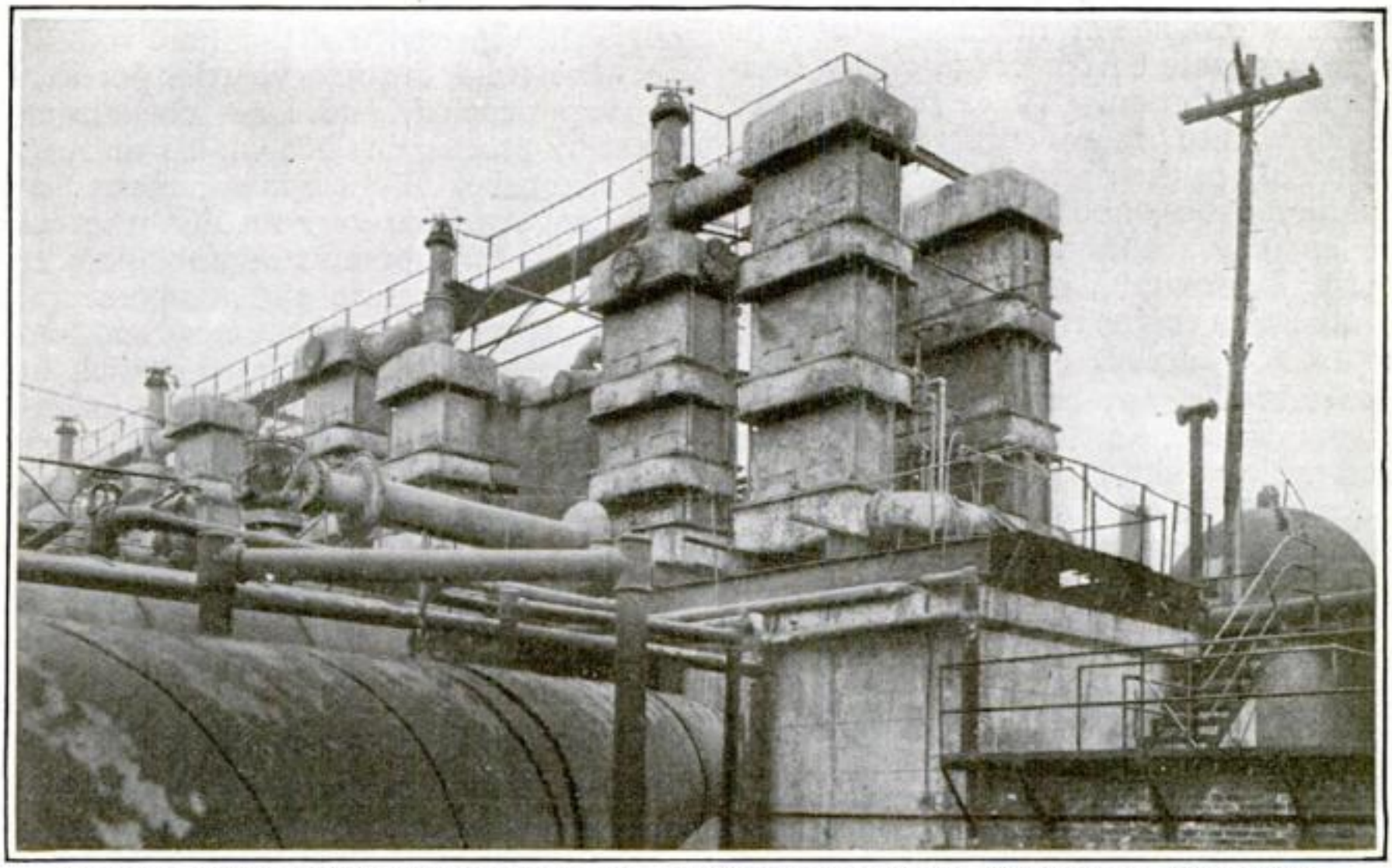
The author is an engineer connected with a great oil-refining company. His article, while it describes the general principles of oil-refining, is intended to explain how lubricating-oil in particular is obtained.—EDITOR.

THERE is a vast difference between petroleum as it flows from the earth and its derivatives. An oil refinery is a region of giant stills, filters, storage tanks, steam and power plants, coal bunkers and laboratories. Its working population is equal to that of many towns. Immense workshops are required to manufacture the hundreds of thousands of barrels, boxes and tins in which its many products are shipped.



The Agitator Is a Lead-Lined Steel Tower for Bleaching Oil and for Removing Impurities

Crude oils are not simple chemical compounds but consist of a physical mixture of different compounds of the element carbon and element hydrogen. Other elements such as sulphur, oxygen, nitrogen and metallic salts, etc., are present as impurities. Each one of these many compounds has its own definite physical properties, such as fixed boiling point, gravity



Battery of Aerial Condenser for Automatically Condensing Different Distillates, Which Are Then Conducted Through the Water-Cooled Pipes to Their Respective "Running" Tanks

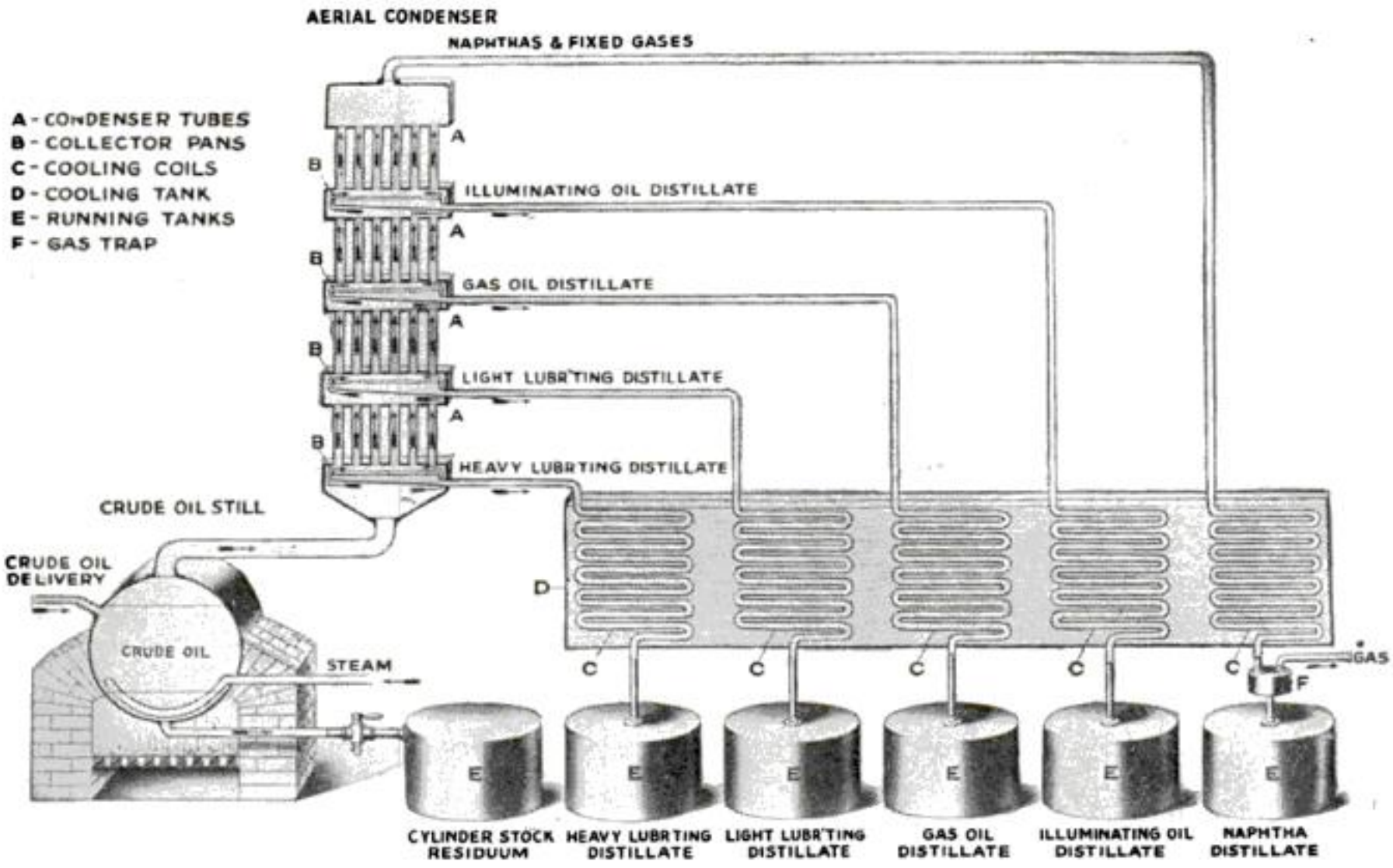


Fig. 1. First Separation of Crude Petroleum Into Groups by Distillation

and other specially distinguishing characteristics.

As cream, butter, cheese, casein, and other products are derived from milk, so are hundreds of different hydro-carbon compounds lying between the extreme limits of gasoline and cylinder stocks or coke, separated from crude oil by fractional distillation. These products are divided into many different grades, according to their physical and chemical characteristics, and to the purpose for which they are used and shipped to all parts of the world, wherever an internal combustion engine is run, a lamp burned, or a wheel turned.

Crude oils may be divided into three main families: those of paraffin, asphaltic and cyclo-naphthene base. There is no sharp line of separation between these groups, since most crude oils found in all fields may contain mixtures in variable percentages of hydro-carbons, belonging to two or more families.

When the crude petroleum arrives through the pipe line and is deposited into storage tanks of large capacity, a certain settling takes place. The semi-solids which settle out consist of amorphous paraffin wax, mud or other earthy foreign matter and impurities.

First Stage—Separation into Groups by Distillation

From the storage tanks the crude oil is pumped into a large cylindrical boiler, called a "crude still."

Distillation as applied to hydro-carbon oil, is the separation of the more volatile portions from the less volatile portions by vaporization, and later condensing them by passing the hot vapors through a cooled tube. Light hydro-carbons like gasoline, vaporize very readily, whereas heavy oils form practically no vapors at atmospheric pressure and temperature; therefore, it is necessary to heat and boil crude petroleum in a closed vessel, in order to accomplish complete vaporization and separation of the different hydro-carbons. Since crude oil is a complex mixture of hydro-carbons, each of which has a different boiling point, a different temperature is required for the vaporization of each compound. Dissolved gas and the lightest hydro-carbons pass over first, and as the temperature is increased, heavier and heavier hydro-carbons are vaporized.

Reverting to Figure 1: The vapors formed are led through a pipe from the still and discharged into the base of an aerial tower condenser. From there they

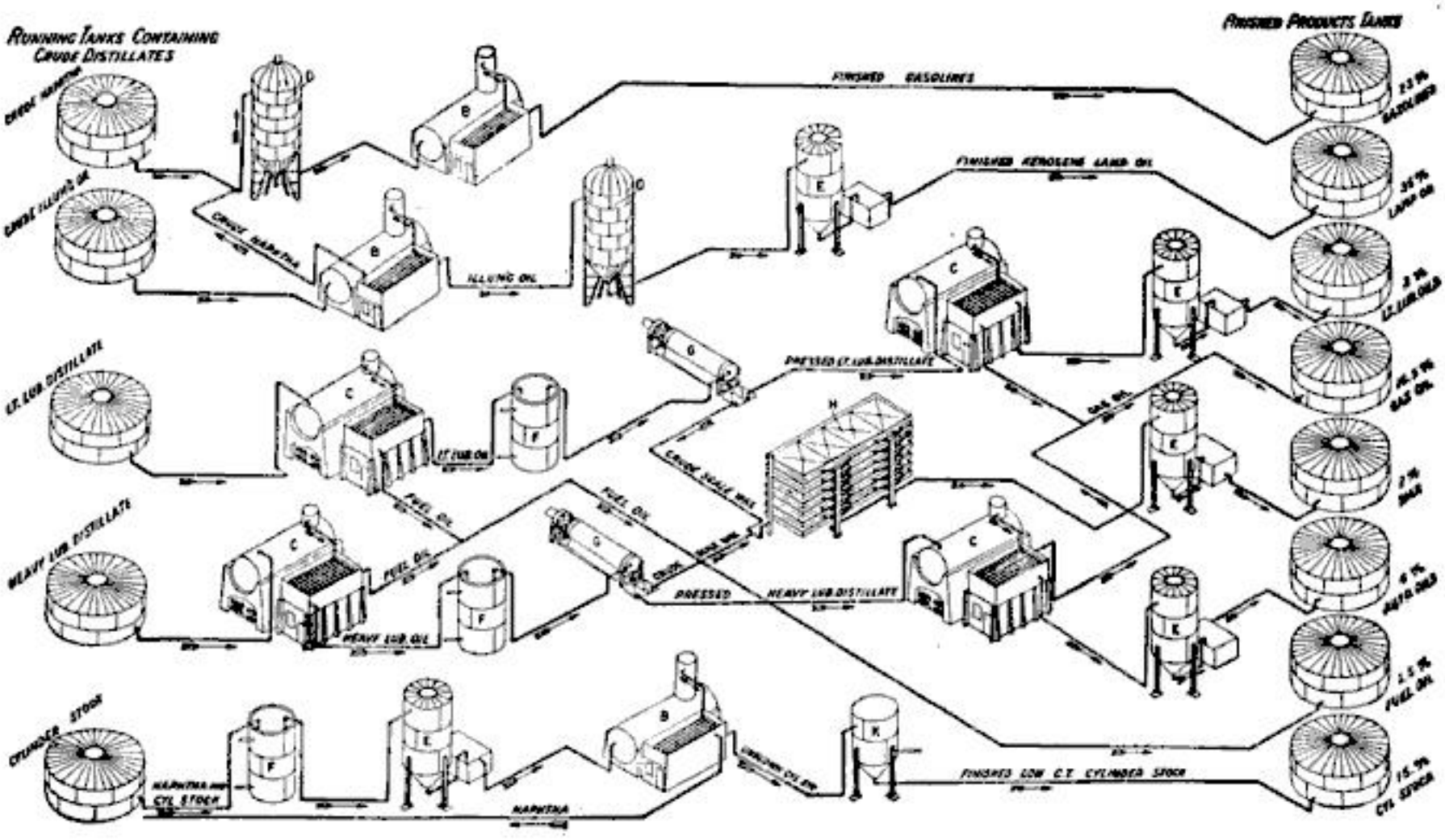


Fig. 2. How Pennsylvania Crude Oil Is Refined

B—Steam Still C—Steam and Fire Still D—Agitator E—Fuller's Earth Filter F—Chilling Tank G—Wax Filter Press H—Wax Sweater K—Air Drying Tank

pass up through alternate boxes and air-cooled tubes, where products of different boiling points are simultaneously condensed and thus automatically separated into groups. The lightest products pass completely through the tower and flow in vapor form to a water cooled condensing coil, where all light hydro-carbons condensable without the application of pressure, are liquefied and separated from the remaining vapors, which are further treated at a compressor plant, for the separation of very light hydro-carbons from the "fixed" gases. Of the remaining vapors, the heaviest condense upon striking the first air-cooled tubes, and the lightest upon striking the last tubes. Intermediate products, lying between the light and heavy ends, condense in the intermediate tubes, depending upon their respective boiling point. The vapors liquefying in different sections of the aerial condenser fall back into corresponding collector pans, whence each is led by way of a separate water-cooled coil to the storage tanks, called "running tanks." The liquids recovered in the collector pans are still at a temperature above their fire points, and it is necessary to cool them down to prevent spontaneous ignition, when they come into contact with air in the running tanks.

Distillation continues until a residue (crude cylinder stock), of about 15 per cent. remains, when the fires are drawn and the remaining oil is pumped from the still through a cooler into a running tank.

The quantity and quality of products obtained from this first separation depend upon the method of distillation employed and from the base or "family" to which the crude petroleum belongs. This description, however, only concerns Pennsylvania crude oil of paraffin base. High quality oils are obtained when the separation is made by distilling under vacuum or by the use of fire in combination with steam injection. Due to the mixture of oil and water vapors in fire and steam distillation, oil vapors pass over at lower temperatures than were fire used alone. This prevents the occurrence of any serious "cracking" of the heavier products.

Second Stage—Separation and Finishing of First Groups

The prime object of subjecting the group-distillates from the running tanks to different processes is to further

separate each group into the final market form of the many products contained.

The secondary purpose of refining is to remove the impurities, color-bearing, and unstable or unsaturated compounds and free carbon. It may be well to point out at this time that in the first group distillation there is no sharp line of demarcation between gasoline and illuminating oil or between any other similar fractions. Heavy constituents are mechanically carried over with the light portions and more volatile products are mixed with the heavy parts. In order to completely separate these, further distillation is necessary.

The crude naphtha distillate is pumped from the running tank to an agitator where it is treated with sulphuric acid, washed with water to remove the free acid and neutralized with caustic soda, again washed and separated from the water. The treated naphtha is next sent to a steam still where it is divided by distillation into various market grades of gasoline and pumped from there to the finished naphtha storage tanks. (Fig. 2.)

The illuminating oil distillate is pumped to a steam still where the crude naphtha contained is separated by distillation and sent to the crude naphtha still. The illuminating oil remaining is sent to an agitator where it is acid treated, washed, neutralized, rewashed and filtered through Fuller's earth (Fig. 3) and pumped to the finished kerosene lamp oil storage tanks.

The crude light lubricating distillate passes from the running tank to a steam and fire still, for the purpose of changing (by heat) the character of the paraffin wax from the amorphous condition to wax that may be crystallized and for separating the fuel oil content. The lubricating distillate then goes to a chilling tank where its temperature is lowered to such a degree as to cause crystallization of the wax. In this chilled condition it is then pumped to a wax filter press, under high pressure, where it is separated into crude scale wax and pressed lubricating distillate. The pressed distillate then goes to a steam and fire still, where the gas oil is separated from it. The remaining distillate is then divided into lubricating oils of different viscosity, varying from very light to medium light, by fractional distillation.

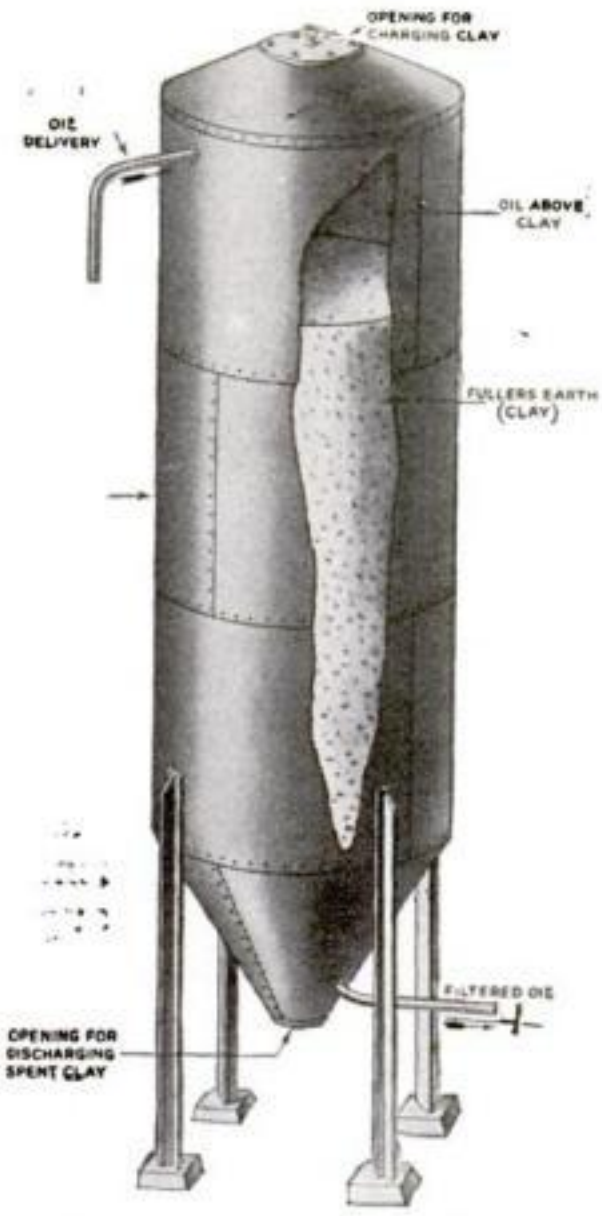


Fig. 3. Fuller's Earth Filter

The oils of different viscosities resulting from this fractional distillation are next sent to a Fuller's earth filter for the removal of color-bearing compounds and free carbon. From the filter, these oils are pumped to the finished lubricating oil storage tanks.

The crude scale wax is sent from the wax filter press to a sweater, where it is separated into scale wax and oil. The scale wax then goes to a Fuller's earth filter, through which it passes to the finished paraffin wax tanks.

The crude heavy lubricating distillate follows the same course in processing as that indicated for the light distillate. Fuel oil and paraffin wax are separated in the same manner. The fractional distillation of the remaining oil results in lubricating oils of heavier body than those recovered by the processing of the light lubricating distillate.

Crude cylinder stock is greatly thinned with naphtha, and then sent to a chilling tank where the paraffin wax, from which vaseline is made, settles out. The oil-naphtha portion is pumped to a Fuller's earth filter for the removal of color-bearing compounds and free carbon. From the filter it passes on to a steam still where it is separated into naphtha and low cold test cylinder stock. From the still the oil is sent to a tank where it is blown with air to remove traces of moisture and then to the finished storage tanks.

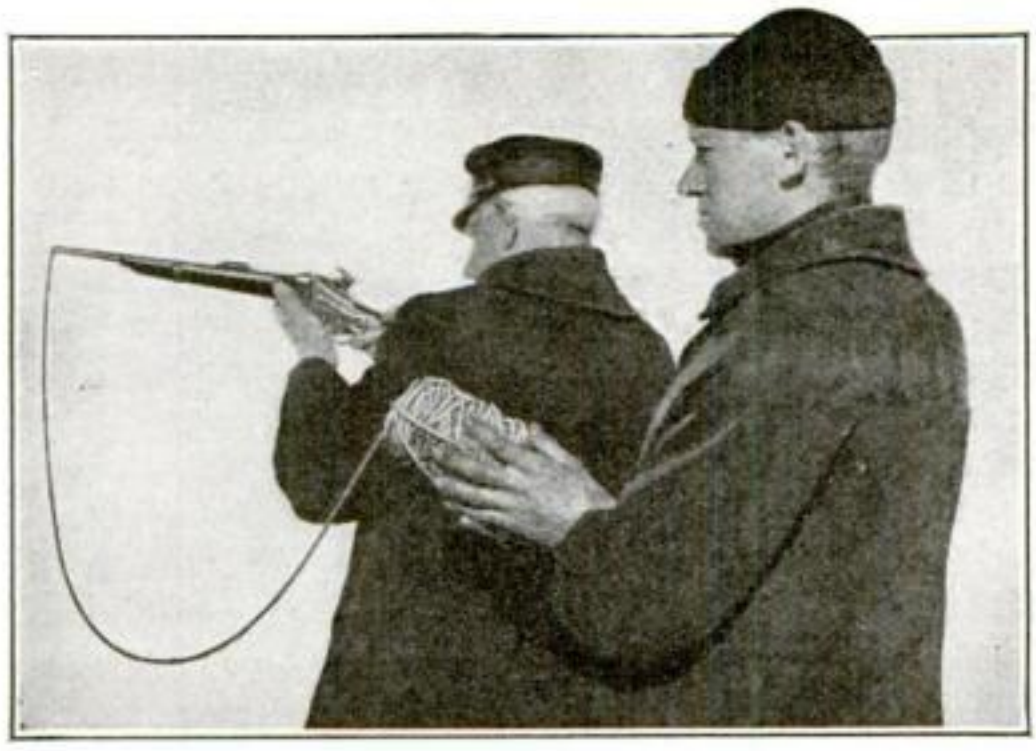
Rapid-Fire Guns Save Lives

In Line Shooting with the Rapid-Fire Guns a Projectile About Six Feet Long Is Used. The End Which Is Inserted in the Gun Is a Cylindrical Piece of Steel Slightly Smaller Than the Bore of the Gun. The Line Is a Hemp Rope About the Size of a Wash Line

THE three and six-pounders with which all the sea-going cutters of the service are armed now are used to shoot lines to vessels in distress. For years they had served as nothing more than ornaments on the decks of the cutters; for it never was necessary to use them in the enforcement of customs and navigation laws. They were carried mainly for their moral effect.

These guns have been found far more effective in line shooting than the line guns formerly carried—small brass cannons of the type seen at life-saving stations along the coasts. Although the cannons were in use for many years, they were never entirely satisfactory. It was almost impossible to aim them with any degree of accuracy, and accordingly line shooting with them was a "hit or miss" matter in the majority of cases.

In line shooting with the modern rapid-fire guns, a projectile about six feet in length is used. The end, which is inserted in the gun, is a cylindrical piece of soft steel slightly smaller than the bore of the gun and about a foot in length. It is tapered down to a rod about a half inch in diameter and five feet or more in length. There is a forged eye at the end of the rod to which the end of the line is tied.



The Old 56-Caliber Sharpe's Carbine Is Also Used Now as a Line Shooter. A Blank Cartridge Is Used to Fire the Projectile to the Vessel in Distress

The line is a loosely-twisted hemp rope about the size of a wash line. About one thousand five hundred feet of

it is woven back and forth around wooden pins set in a receptacle the size of a trunk, known as a "faking box." After this operation the box is turned upside down and the frame work holding the pins is withdrawn, leaving the line ready to be "fed out," without becoming tangled. Prior to the insertion of the projectile in the gun, the first twenty or thirty feet of the line are dampened, so as to give it more elasticity and lessen the danger of its parting. A cartridge containing about ten ounces of black powder is inserted in the breech of the gun which is then aimed and fired.

After having traveled about two hundred feet from the gun, the heavier end of the projectile causes it to turn in mid-air and assume the position of a comet with a long tail streaming behind it. Successful shots have been made with the three and six-pounders up to a distance of one thousand two hundred feet, and it is believed by Coast Guard officers that further experiments with the guns will result in shots of two thousand feet and more.

The use of the rapid-fire guns for line shooting is something entirely new. For some time the Coast Guard has been utilizing shoulder guns for line shooting when a cutter can get to within 450 feet of a vessel in distress. The shoulder gun is another example of a gun designed to destroy but now used to save. The gun used for this purpose is the old 56-caliber Sharpe's carbine, the first breech-loading arm extensively used by military forces in this country. Although of obsolete type the weapon is well suited for line shooting and costs much less than any other type of gun that could be provided for the purpose. The barrel is cut down to about fifteen inches in length and the breech block is constructed so as to receive a center-fire cartridge.

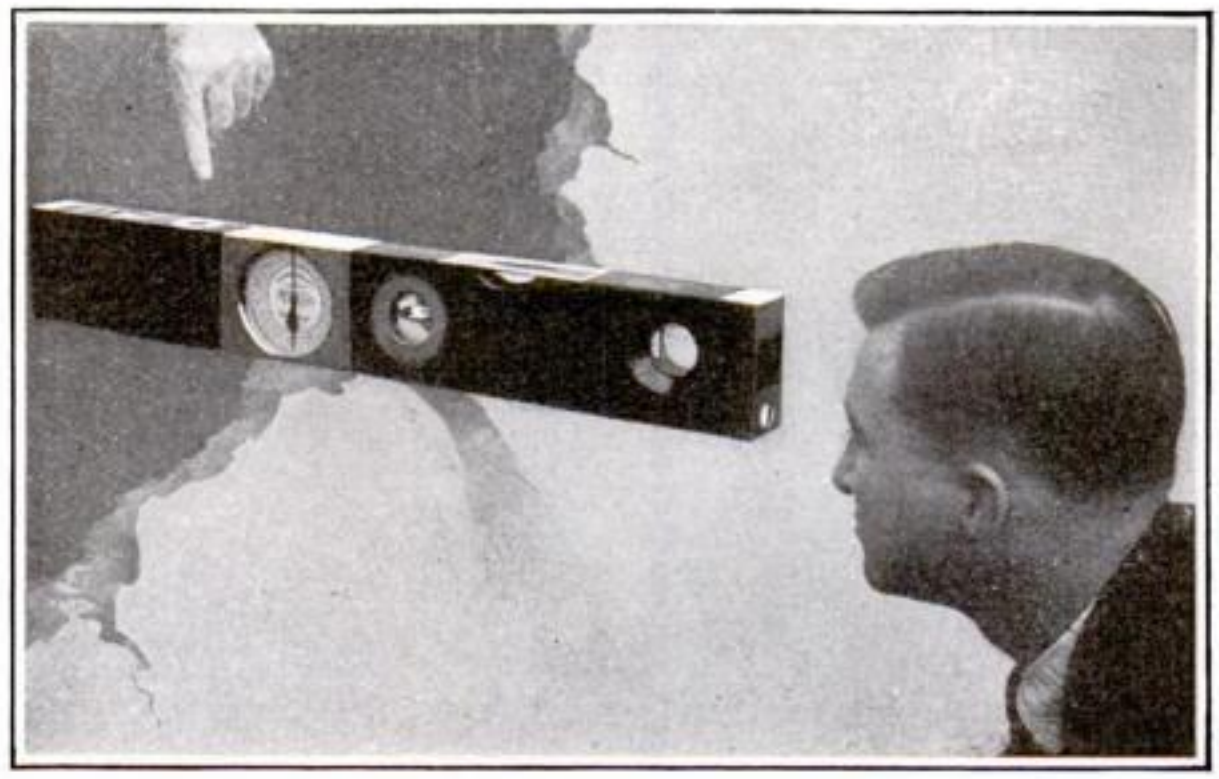
The projectile, shaped like that fired in the big guns, is only about a foot long, and the largest end is about a half inch in diameter. The line is also of a smaller size, and, instead of being held in a "faking box," is wound into a ball, which a sailor who stands beside the gunner holds in his hands. The line is wound in such a way as to allow it to "feed out" from the center of the ball. A regulation 56-caliber blank cartridge is used to fire the projectile.

Carpenter's Level, Compass, Grade-Finder and Periscope Combined

A LEVEL and grade finder has been placed on the market which will not only give the exact distance out of the true level but will enable the operator to ascertain at one glance the true slant on any line or grade, either in degrees, inches or percentages or all at the same time.

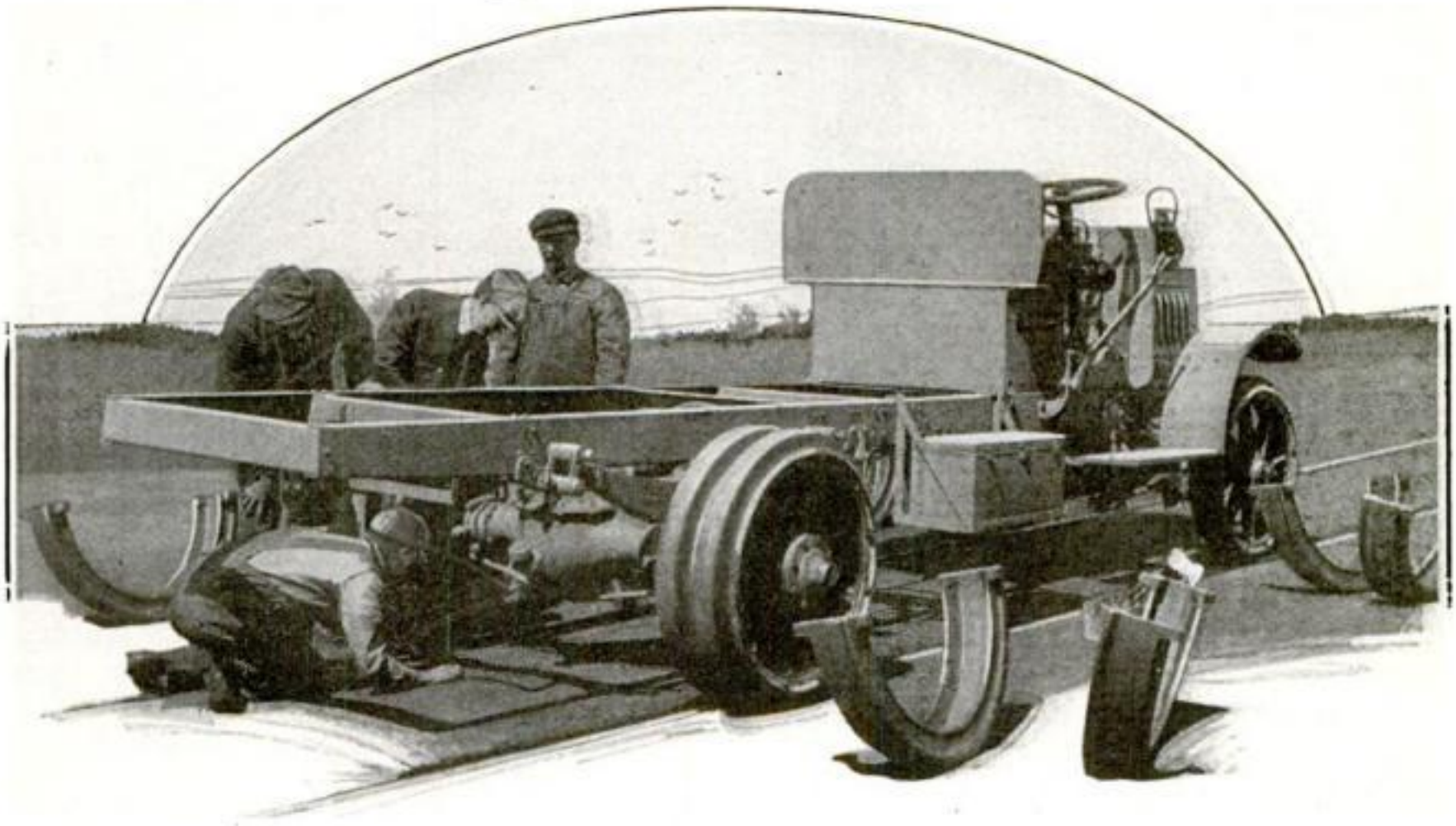
It can be mounted on a tripod and used in all forms of grading, laying out roads, landscape gardening, placing of pipes for drainage, ascertaining fall of water, grade of hills for automobilists, cutting of rafters and laying off and leveling buildings.

A spirit level glass placed in the middle of the instrument can be seen from all sides if it is placed at an elevation. By noticing the pointer on the dial it will give three guides for leveling. One of the most novel features of the instrument is an adaptation of the periscope principle in determining grades and their percentages.



If Placed at Sufficient Elevation, a Spirit Level Glass in the Middle of the Instrument Can Be Seen from All Sides. The Pointing Hand Can Be Plainly Seen Through the Lens

Railroading with Motor-Trucks



On the Three-Ton Trucks the Front and Rear Tires Track Exactly and Are the Same Size. The Steel Rings Grip the Rubber Tires with Great Force in a Tight Fit. It Requires Only About Fifteen Minutes Time for Two Men at a Wheel to Fit On or to Remove the Flanges

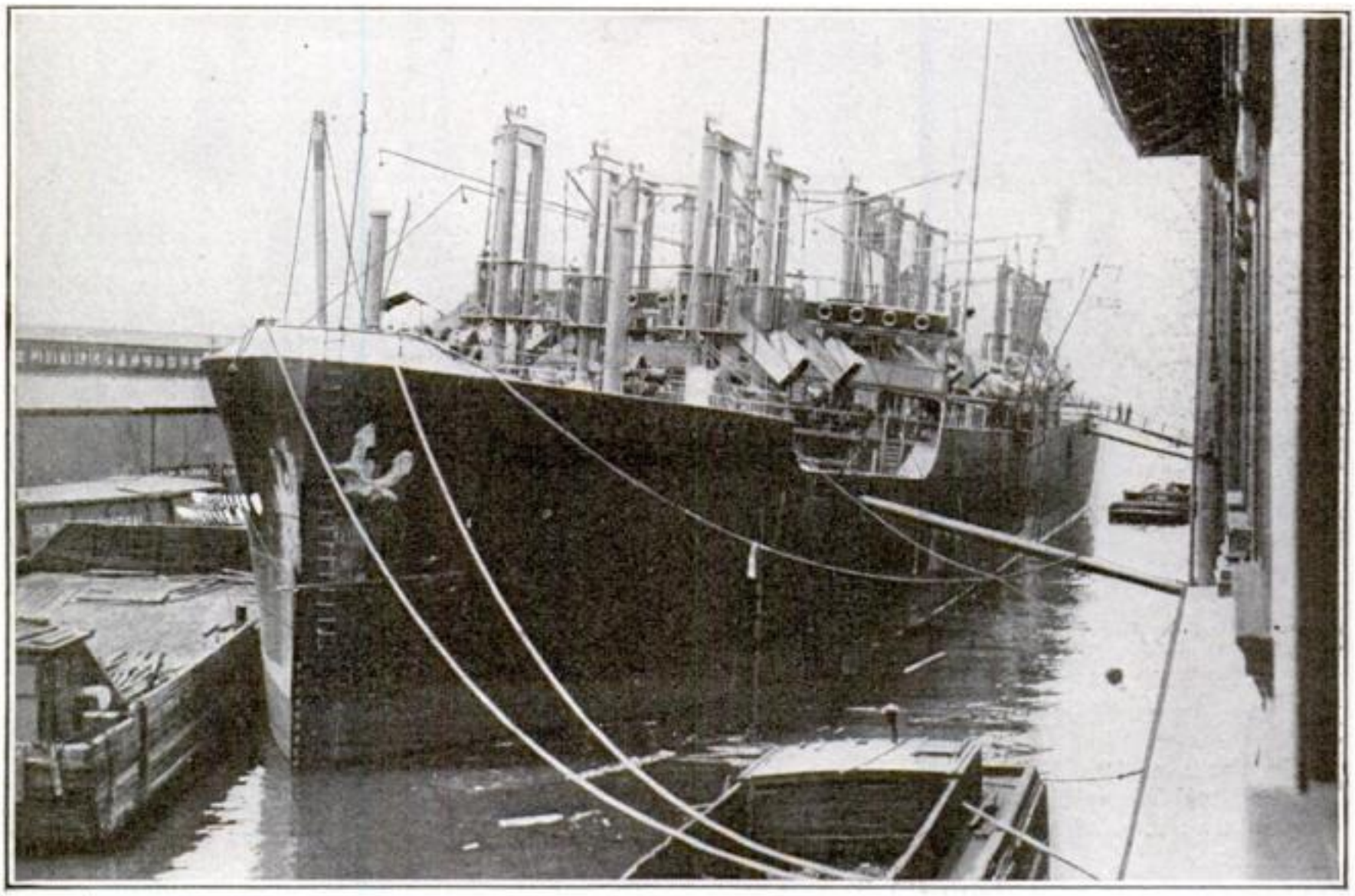
THE very latest scheme which has been employed for bringing the automobile up to maximum efficiency and usefulness is, as so many other inventions and improvements have been, a result of war times. The Army wanted motor-trucks that could run on railroad tracks, making them of service over the route to Mexico, in places where the railroad tracks make otherwise impassable sandy stretches usable. So A. L. Riker, an engineer widely known as a designer and builder of automobiles and motor-trucks, devised and developed a scheme for using flanged wheels on three-ton trucks, permitting their use on rails of standard width.

The flanges are made of steel, which is cast in one piece and machined; after which it is sawed apart at the bolt-lugs. The inside is finished to the same contour as the rubber tire and is made to fit so tightly that it grips the rubber tire with great force.

A set of the flanges can be put on in fifteen minutes, two men being employed on each wheel. The truck is jacked up and the flanges are pounded on with a maul. Then the bolts are pulled up very tight. Removing the flange requires no greater length of time, but in an emergency the trucks can be driven on the roads without removing the steel rings.

The Trucks Equipped with the Flanged Wheels Can Be Run Over the Ordinary Railroad Tracks of Standard Width. The One Above Was Loaded with Munitions and Carried Twenty Soldiers Ninety-Three Miles at Nineteen Miles an Hour

The Biggest Coal Ship in the World



There Is Nothing Romantic About the "Milazzo." She Is Built for the Brutally Practical Purpose of Carrying Coal. By Means of Twenty Cranes on Her Decks 14,000 Tons of Coal Can Be Unloaded in Forty-eight Hours. Shovels Are Unnecessary on the "Milazzo"

LOOK at the "Milazzo" and watch her unload 14,000 long tons of coal and 4,500 tons of oil, and you say at once: "An American designed her—she is practical." In truth, there is nothing quite like her in the whole world, as ships go. On the other hand, she was designed not by an American, but by an Italian, Captain Emilio Menada, who has earned a reputation for himself as an inventor of transporting machinery.

The "Milazzo" was built to handle bulk cargoes, such as grain and coal—built, moreover, to handle them with the least possible human effort. Accordingly, she is simply an engine-driven hull and a mass of elevators and chutes.

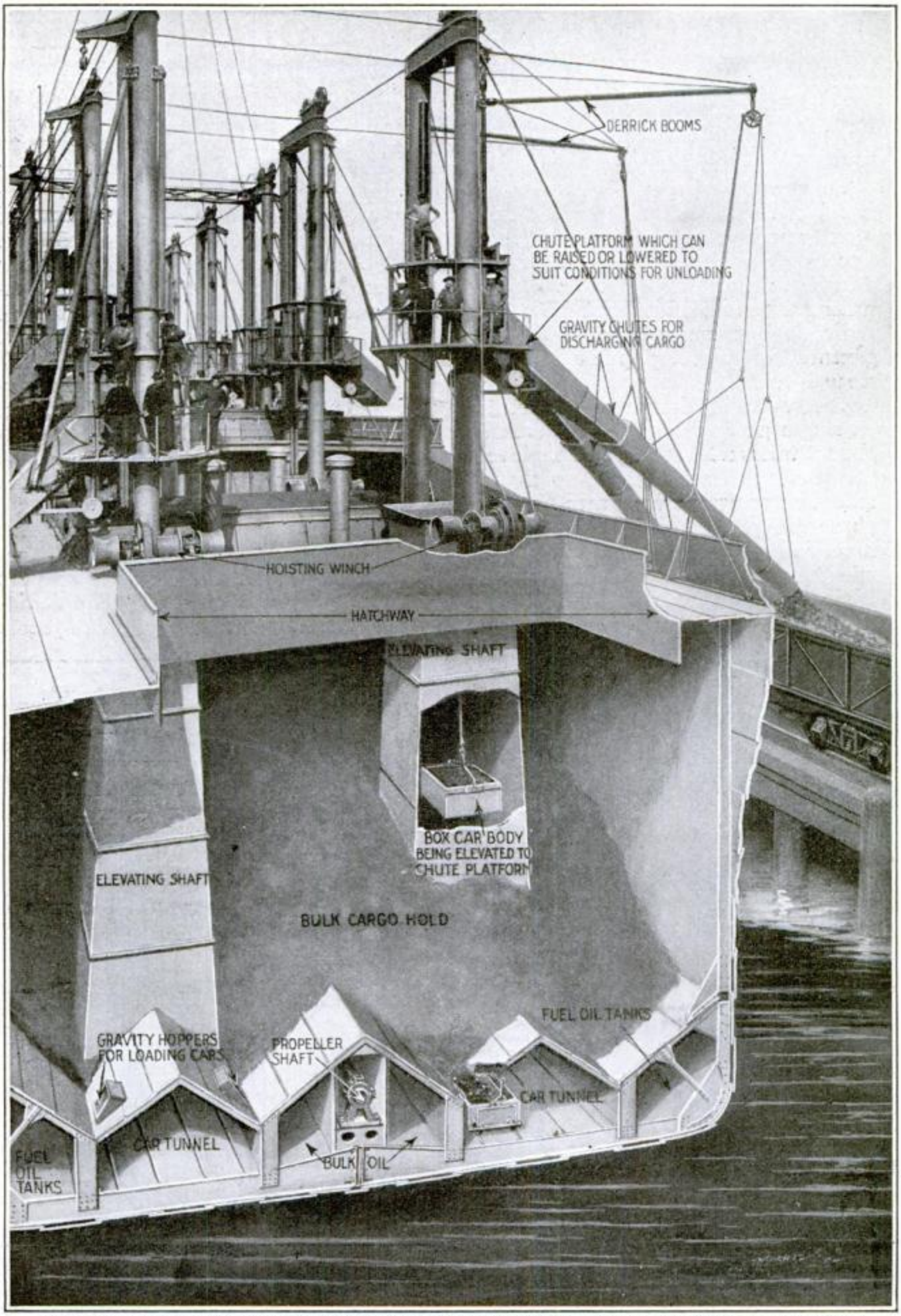
Eight water-tight bulkheads, extending to the main deck, divide the hull of the "Milazzo" into nine compartments. The central compartment contains the engines and boiler fuel. Salt water ballast is carried in the extreme forward and extreme after compartments. That leaves six compartments for the coal.

If you will study the sectional view of the "Milazzo," which appears on the opposite page, you will see that the compartments are merely coal-pockets, similar to those built on wharves. Beneath the coal-pockets, little cars run on rails. When doors, cut in the slanting planes forming the bottoms of the coal pockets, are opened, the coal runs down into these cars by its own weight. When a car is full, it is lifted bodily through vertical elevating shafts up to the main deck to an unloading platform, adjustable in height. Then it is tilted, and the coal runs into chutes. Shovels and grab-buckets are unknown on the "Milazzo."

The 4,500 tons of oil are carried in side tanks forming a double bottom.

With her gross tonnage of 11,477, the "Milazzo" is the largest steamer thus far built for cargo carrying. She is four hundred and ninety-two feet long and draws twenty-six feet of water. Her displacement is 20,040 tons.

A Vessel Built to Carry Coal



Far Down in the "Milazzo's" Hold Are Tracks for Cars. Above the Tracks Are Coal Pockets. Open the Doors in the Pockets and Coal Drops Into a Car. The Car Is Raised Bodily Through Shafts to a Loading Platform, and the Coal Shot Into Cars or Lighters

Mechanical Joys of Coney Island

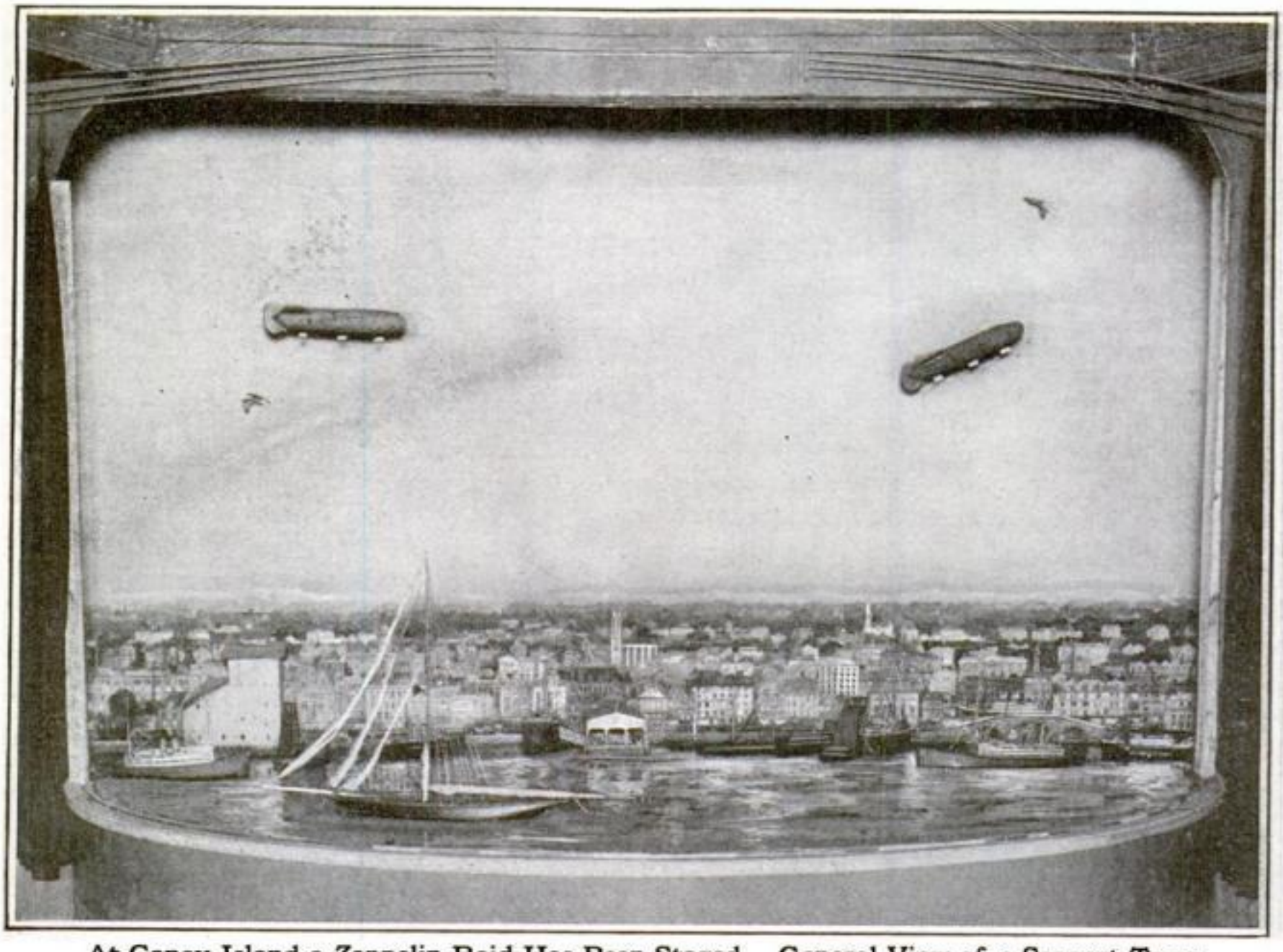
By Stephen W. Symons

HALF the people who go to Coney Island and similar pleasure resorts, have but one aim in view—to get their fill of thrill. That being the case, an art which may be called "thrill engineering" has been developed. Strange as it may seem, thrills, to be of any commercial value, must not be really dangerous, but must have a goodly admixture of that popular element "Safety First."

Anybody could design and operate, for a single performance, a real smash-up, but it takes a knowledge of engineering to produce a near smash-up that is as safe as a cruise in your arm-chair.

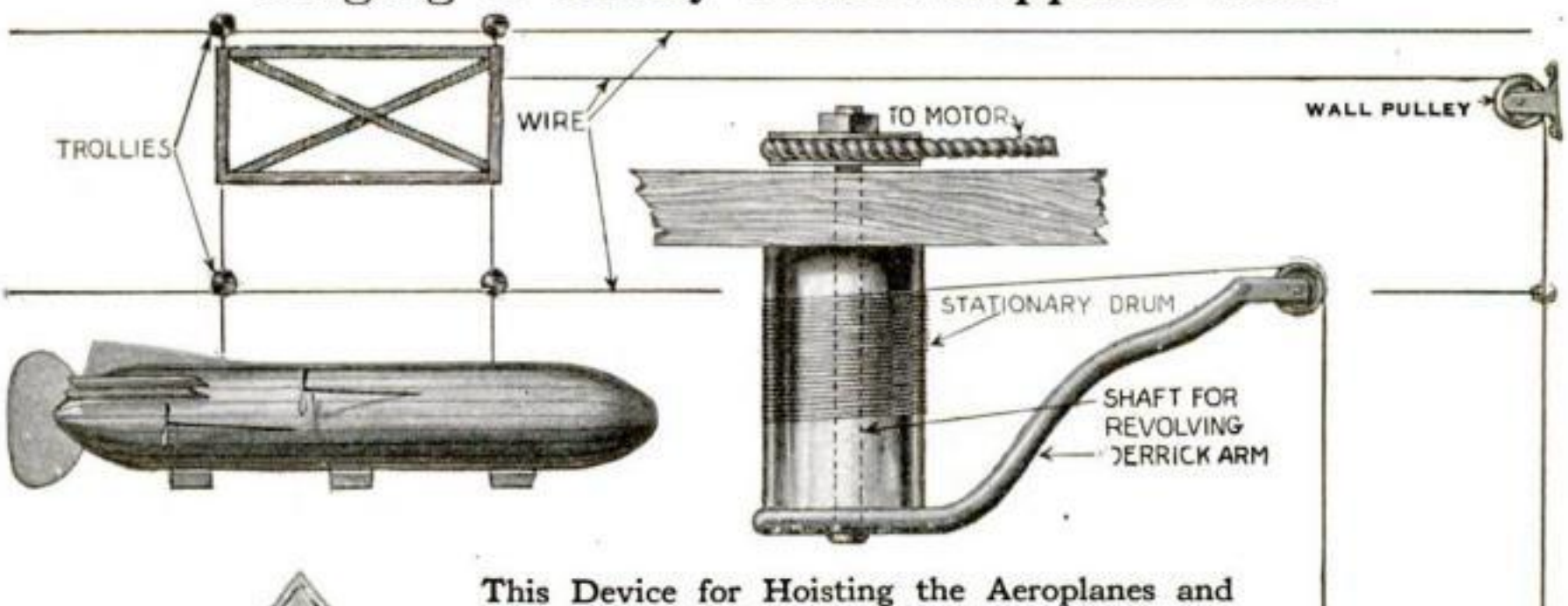
Three things are necessary to make a commercially successful "Thriller." It should have a genuine thrill or some really interesting feature in it; it should be absolutely safe; and it should be sufficiently economical in operation to make it possible to reduce the fee for admission to a figure well within the means of the average purse. Some of the most successful devices are based on the natural aptitude of many of our supposedly sophisticated city folk to look and act foolish. Others, designed generally for the younger folk, give a real physical thrill, a "shoot the chute" or near smash-up. Still others are designed to suit the more sober folk, and though thrilling enough for colder temperaments, do not contain that element of apparent danger so delightful to the younger generation.

A good example of this particular variety is pictured on the opposite page. The scene depicts a quiet little seaport in England. It is entitled "The Aerial Night Attack," and represents most

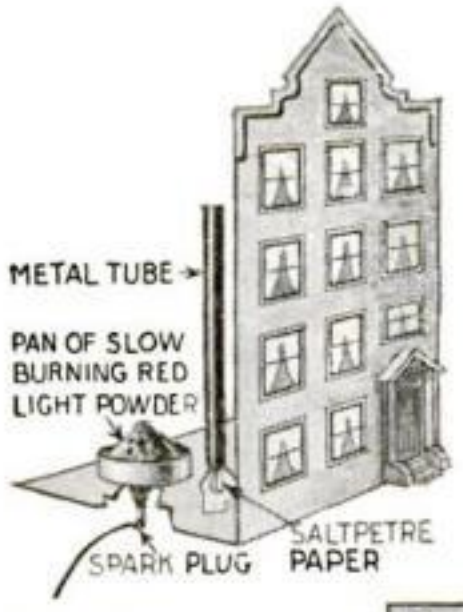


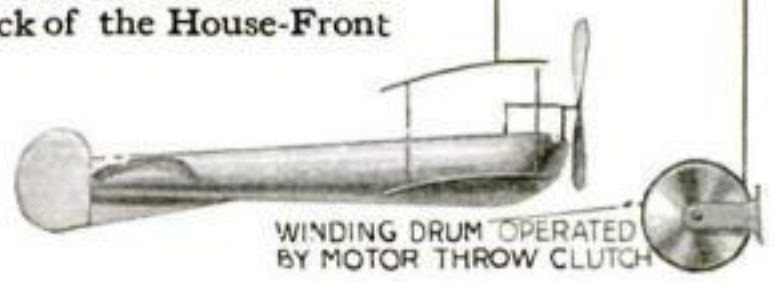
At Coney Island a Zeppelin Raid Has Been Staged. General View of a Seaport Town in Which the News of an Approaching Zeppelin Has Been Received. Aircraft Are Dispatched to Meet the Invaders and They Mount in Great Spirals to the Sky

Staging a Coney Island Zeppelin Raid

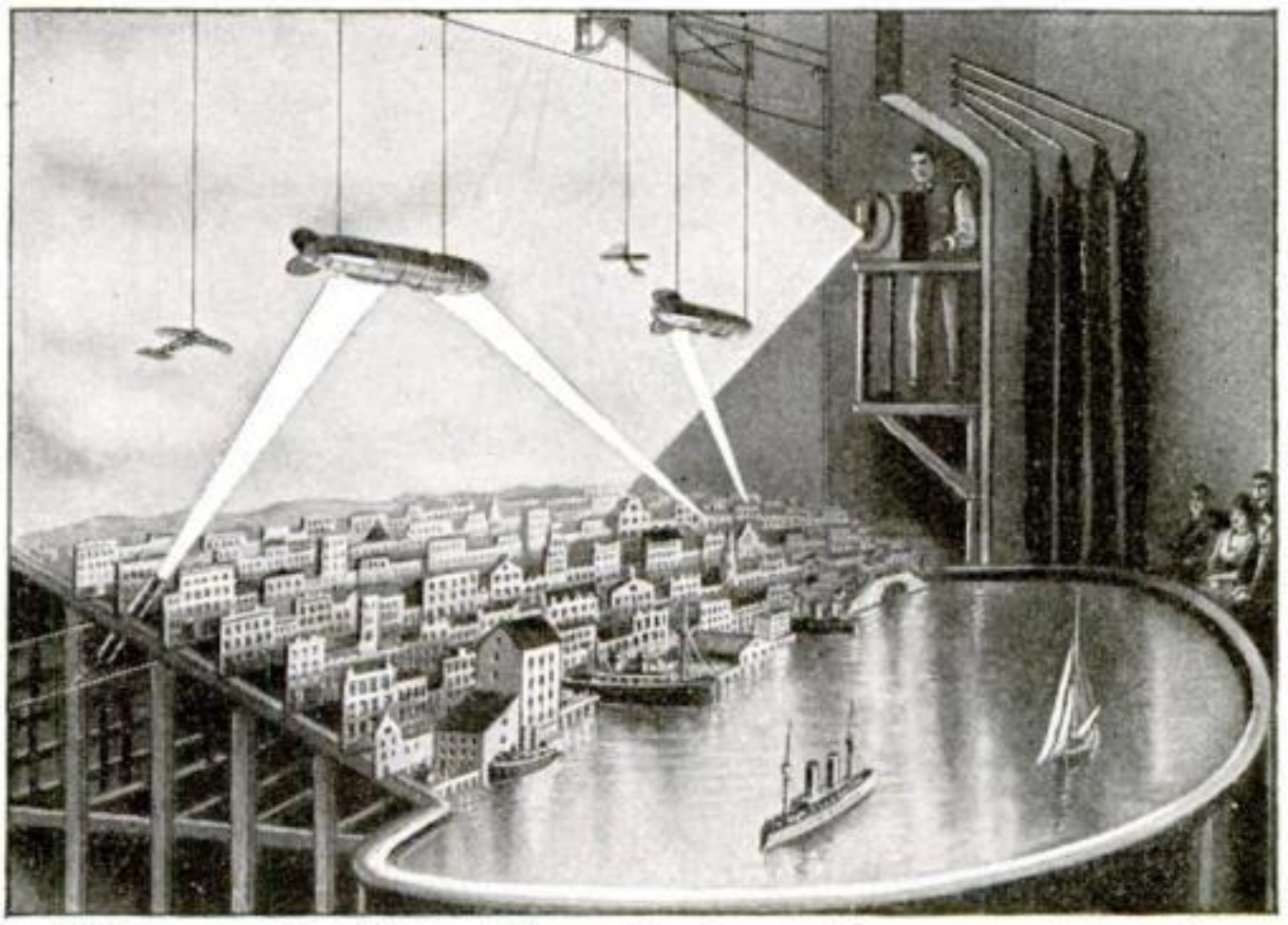


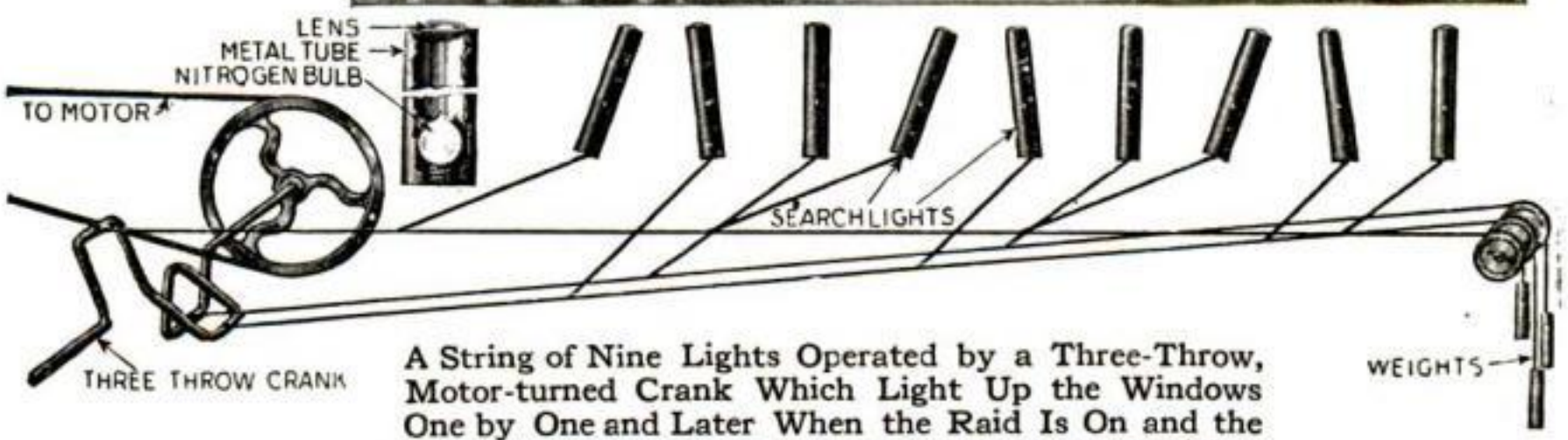
This Device for Hoisting the Aeroplanes and Revolving Them at the Same Time So as to Make Them Rise in a Realistic Spiral Consists of a Stationary Drum Attached to a Beam Set High Above the Stage and at the Bottom a Derrick Arm Which Is Revolved by a Small Motor. The Saltpetre in the Metal Tube and the Red Light Powder Back of the House-Front Are Ignited as the Bomb Is Dropped and Give the Effect of an Explosion and Conflagration Inside of the Dwelling





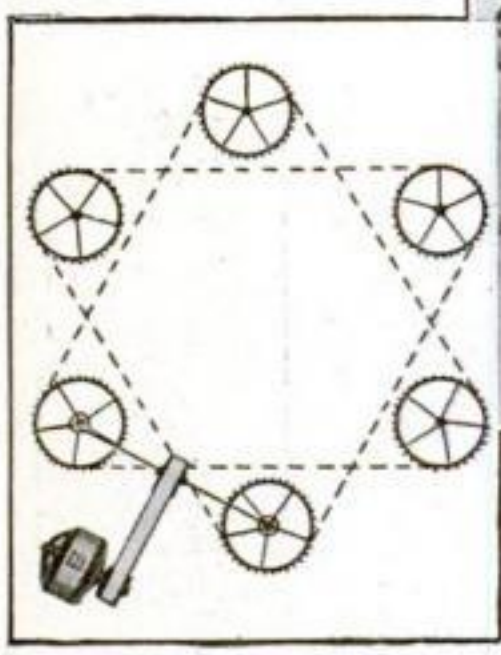
The Mechanism Which Gives the Impression of Distance. The Operator's Cage and Switchboard Are Seen in the Upper Right-Hand part of the Illustration. The Placing of the Searchlights Is Indicated at the Left of the Picture. In the Tank Which Represents a Harbor, a Small Steamer Is Floating in the Wings Until the Proper Moment for It to Appear

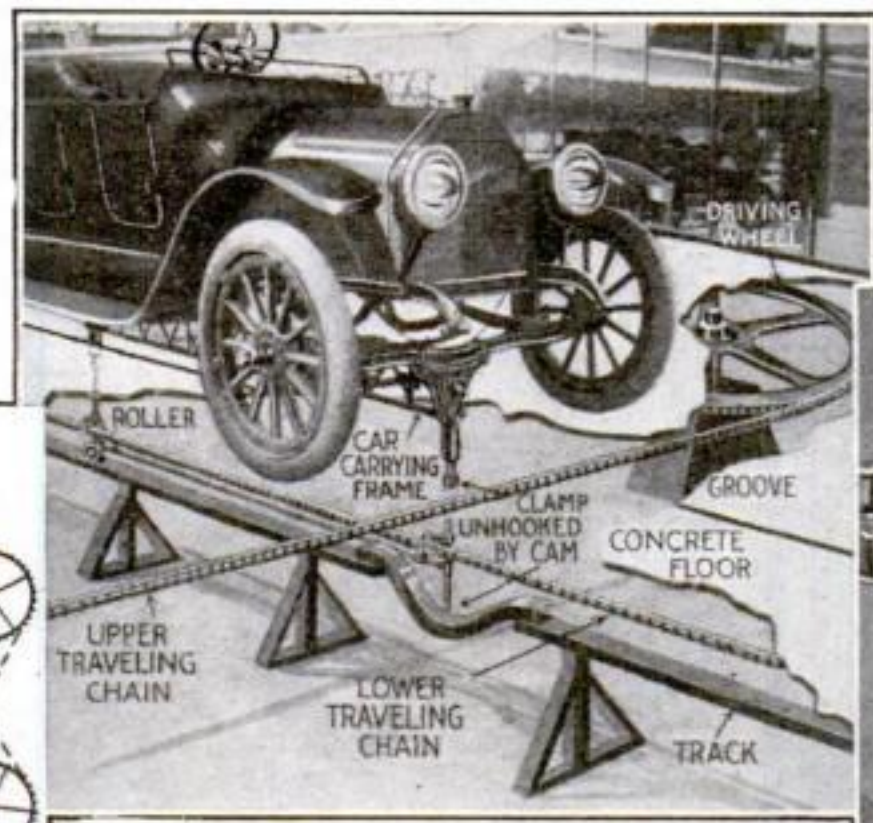




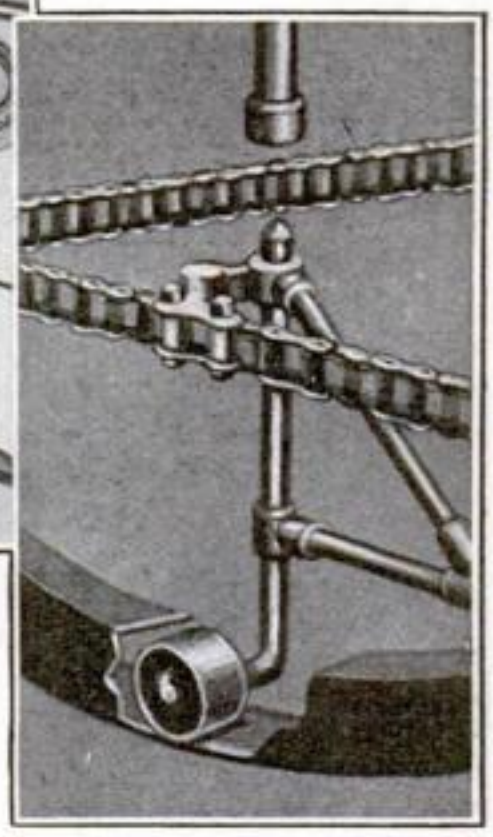
A String of Nine Lights Operated by a Three-Throw, Motor-turned Crank Which Light Up the Windows One by One and Later When the Raid Is On and the City Is in Darkness Are Used as Revolving Searchlights

Below: Plan of Interdependent Sprockets and Chains. One Sprocket of Each Series Is Connected by a Shaft to the Corresponding Sprocket of the Other

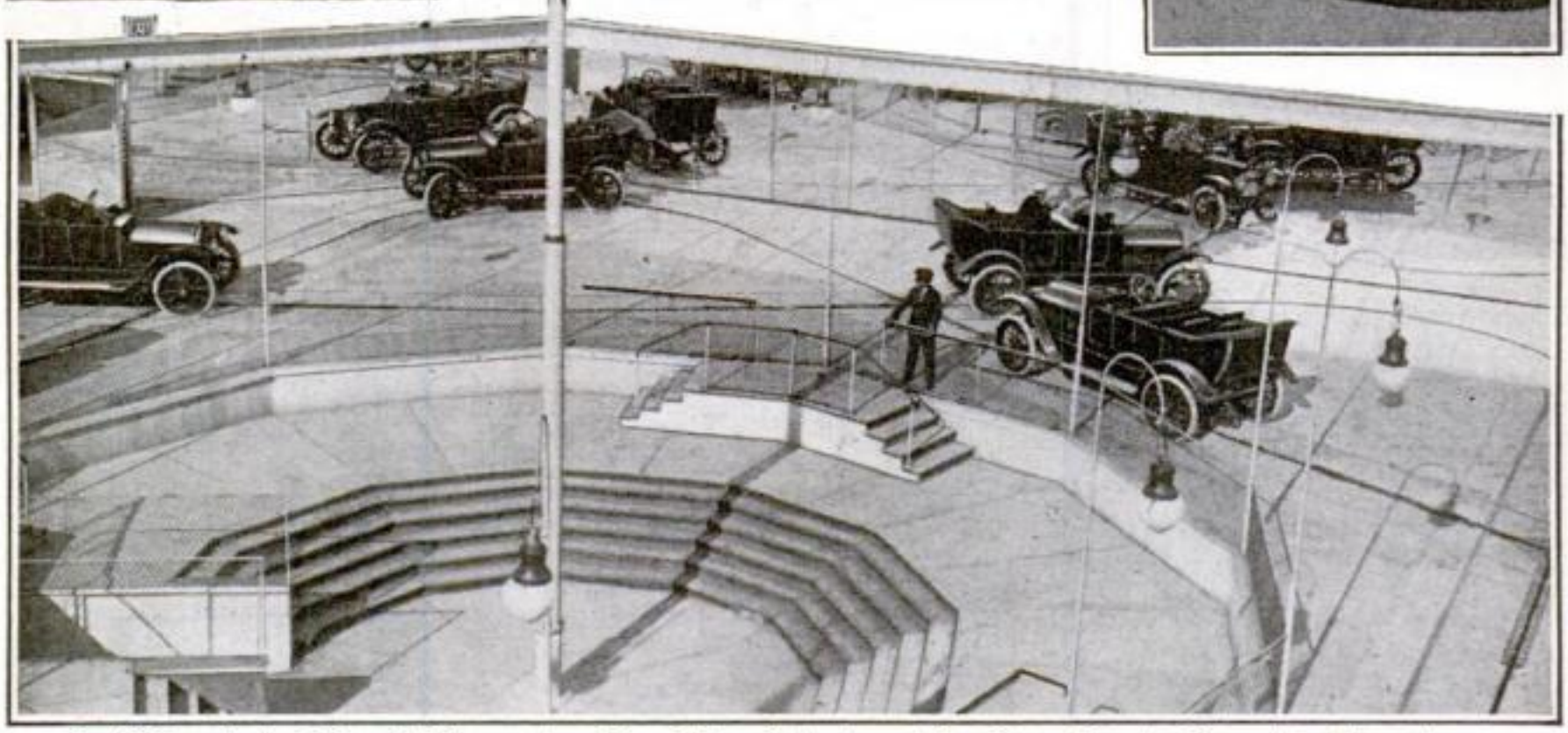




A Roller on Each Clamp Runs on a Track Placed Beneath the Chain and into a Cam Which Lowers It



The Automobiles Operated by the Lower Chain Are Attached to This Chain by Movable Clamps Which Permit the Chains to Pass One Above the Other Where the Tracks Cross



In "The Auto Maze" There Are Two Sets of Automobiles Speeding in Opposite Directions on Two Intersecting Triangular Courses. The Cars are Operated by Two Chains Under the Floor and Driven by Twenty-Foot Sprockets. A Collision Seems Almost Inevitable

faithfully a town which actually underwent several nocturnal raids. The representation is so good that many, familiar with the town, would immediately recognize it.

The advent of the airships, which drop murderous bombs on the inoffensive little town, makes the spectators feel that they are really present at the raid.

The other form of thriller, designed for purely physical thrills, is well represented by the next figures.

Have you ever been in an automobile smash-up? If you have, you know what it feels like, but if not you can get all the excitement with none of the actual danger. In this latest "thriller" the impression given is that a serious smash-up is inevitable. The speeding cars approach each other at right angles, and, just as a collision is about to take place, the cars glide gently by with several inches to spare. The safety of the device is assured by the very complete yet simple mechanism pictured. Simplicity is really the keynote of a device of this nature; complication means unreliability and possible danger.

The "Spinning-Wheel" Gun

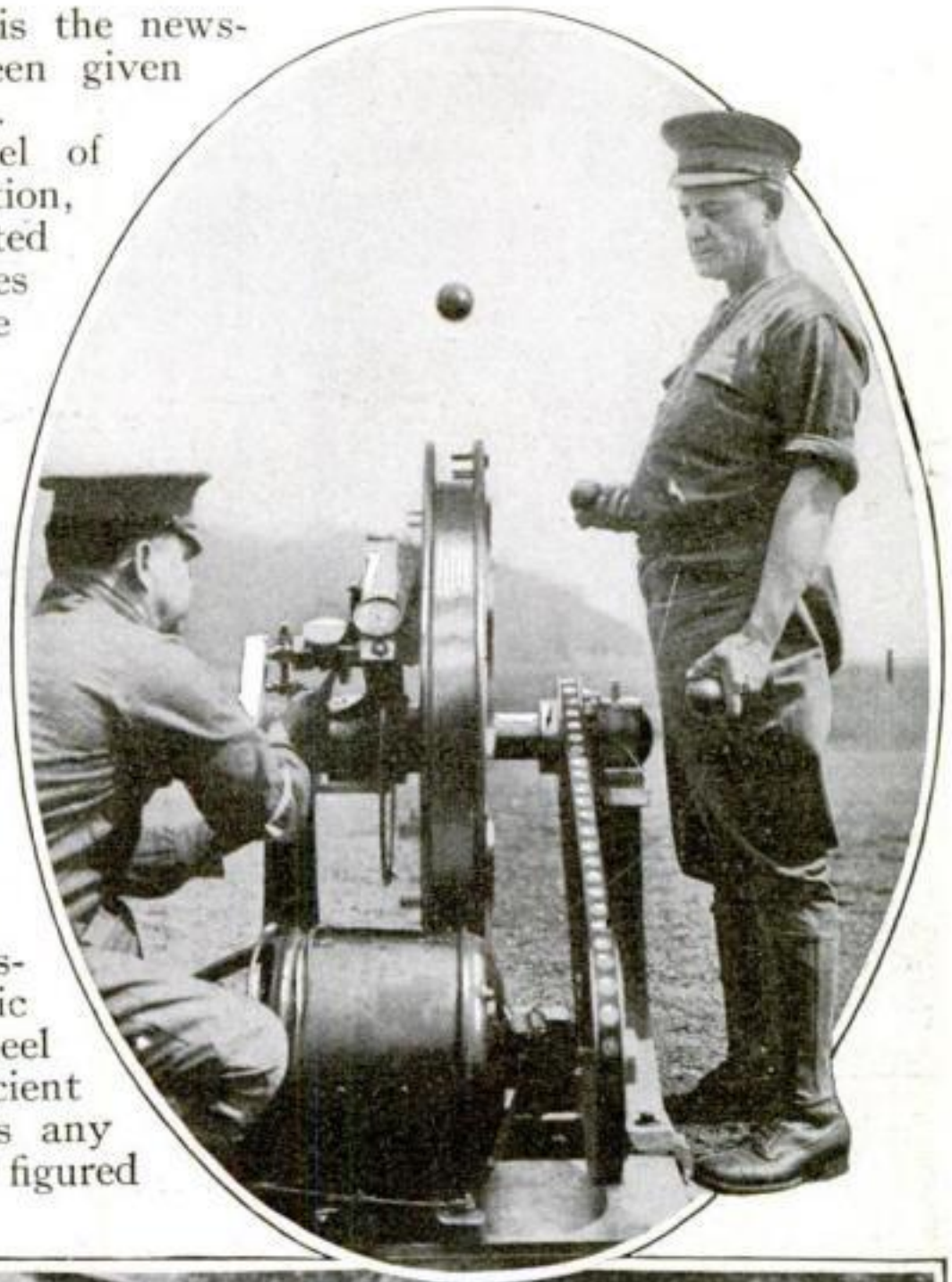
THE "spinning-wheel" gun is the newspaper name which has been given an odd engine of destruction.

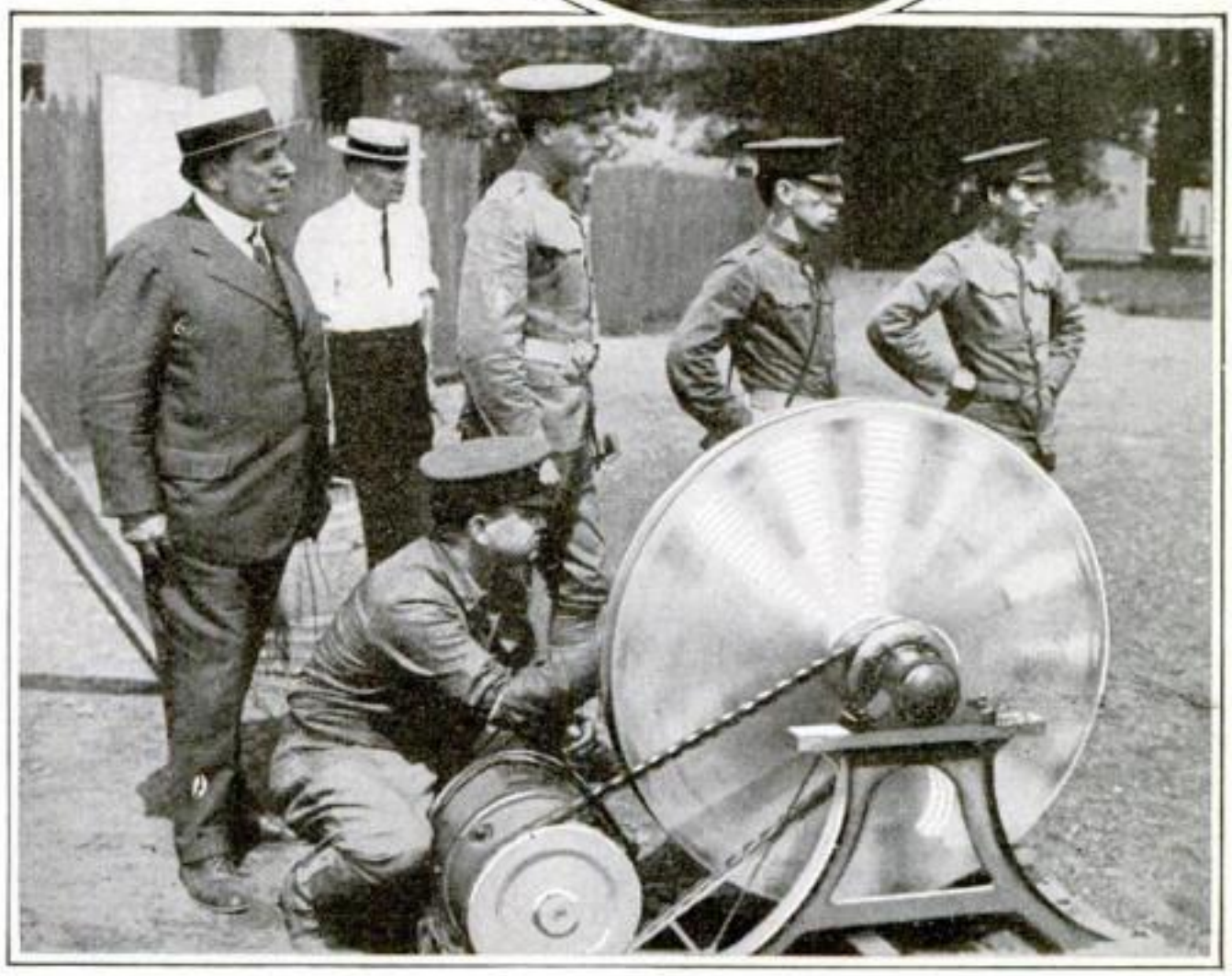
The gun consists of a wheel of aluminum and copper construction, mounted on ball-bearings supported by a suitable frame. Projectiles are placed in pockets in a groove in the rim of the wheel, which is rotated at a high rate of speed by an electric motor to which it is belted. The projectiles are automatically released by a mechanical device and hurled at the object at which they are sighted.

The new gun has many obvious faults, any one of which renders it worthless as a weapon of warfare. In the first place its operation necessitates the use of electric current which makes field service practically out of the question. Even with an ample electric current supply on hand the wheel could not be rotated with sufficient velocity to hurl the projectiles any appreciable distance. It has been figured out that a speed of at least eighteen thousand revolutions a minute would be needed to throw a projectile one thousand yards. It would be difficult to get a motor or bearings which would stand such terrific strain.

The "centrifugal gun" would necessitate the use of spherical projectiles, whereas the type which has been found most efficient is long and tapered and has a detonator at its pointed end.

The gun is designed to supplant hand grenades.

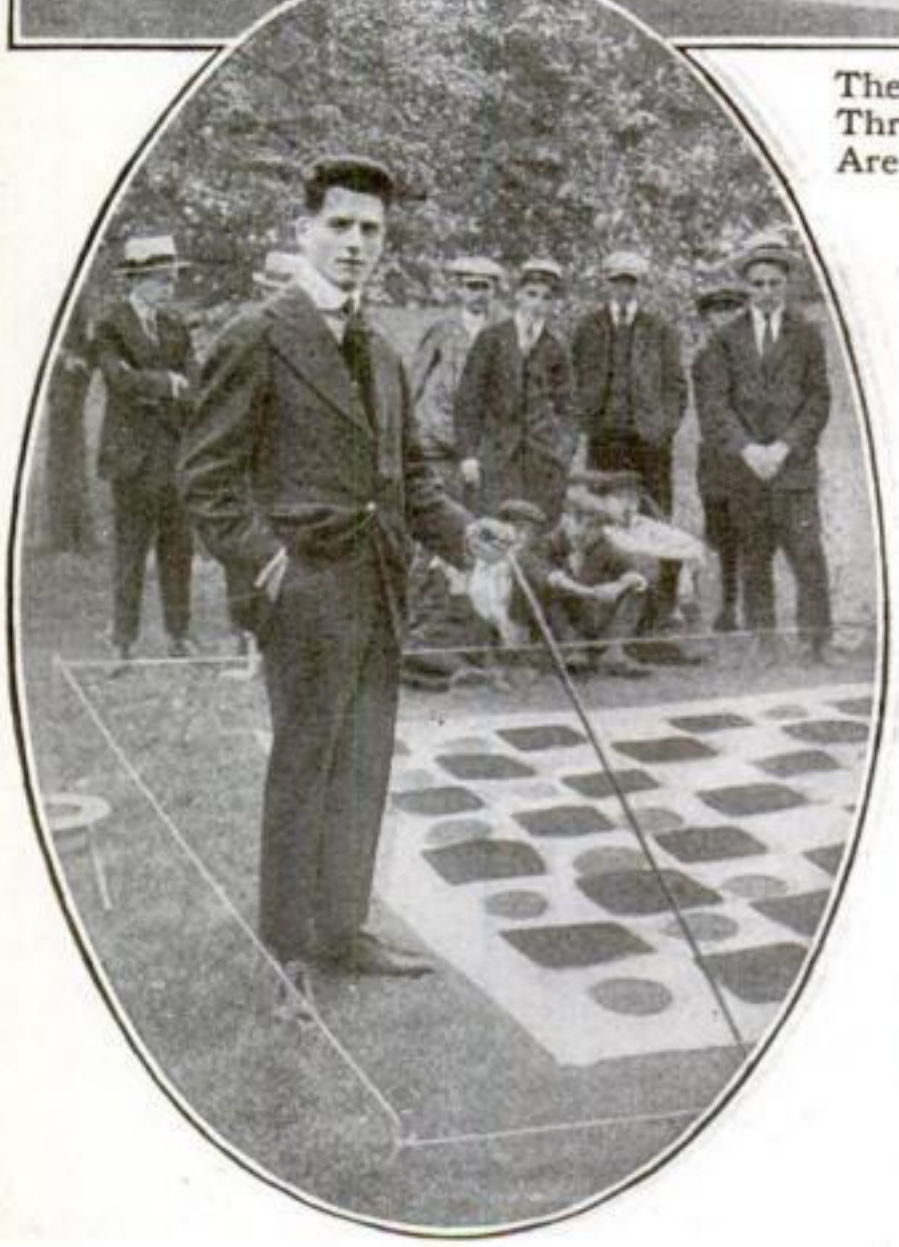




The Gun Consists of a Wheel Constructed of Aluminum and Copper Mounted on a Frame and Rotated at High Speed by a Motor

Checkers as an Out-Door Sport

The Dark Squares Are Patches of Grass Showing Through Cut-Out Holes. The Checker Disks Are Shoved from One White Square to Another



Dr. A. George Goldstein Illustrating the Moves and the Ordinary Rules for Playing Out-door Checkers

A RECENTLY invented game called Lawn Checkers, which is sponsored by Christy Matthewson, is being popularized at the Prospect Park Tennis Courts, in Brooklyn, N. Y., and tournaments are being arranged by Dr. A. George Goldstein. The game is played on a 12-foot canvas "board" stretched out on the lawn. The squares are the size of an ordinary table napkin, and the alternate colors are green and white. The green squares are simply square holes cut out of the canvas at the proper intervals. The checkers are red and blue aluminum disks, one side of each being adorned with a star to represent the king or queen. The disks are shoved from one square to another by means of a long bamboo stick.

Teams of from two to twenty may play matches, each player being allowed thirty seconds to make a move. The ordinary rules of chess are followed and prompting is strictly forbidden.

Fighting Infantile Paralysis

NEW YORK CITY has been fighting an epidemic of infantile paralysis. More than two thousand five hundred have contracted the disease and six hundred have died. Health authorities of nation, state and city assisted by eminent specialists in children's diseases, including Dr. Simon Flexner, head of the Rockefeller Institute, and Dr. Noguchi, the Japanese specialist, have joined forces in fighting the scourge, which, for the last twenty-five years, has baffled the medical profession.

The disease has been confined largely to the New York district, although a score of other states have reported child victims. The part played by the metropolis to keep down the death rate and to clean up every possible spot that might breed germs of infection has been instructive. Every department of the municipal government is co-operating with the Mayor, the Red Cross, the city's physicians, an army of nurses in addition, and federal authorities. Health Commissioner Emerson has called out New York's one thousand "home guards"—citizens trained under police direction for public duty in time of crisis—to join in the crusade.

The motion-picture theaters have been barred against children, as have the public playgrounds and recreation piers. One of the large film companies has issued fifty prints of a special release on the subject which will be exhibited in all the theaters and on motor-trucks equipped with translucent screens. A lecturer from the New York Board of Health accompanies each of the trucks and lectures to parents as the film pictures are projected on the screen. At first, when the plague was confined to New York City, the film company planned to give the illustrated lectures only in local districts but this plan has been altered and the prints are being sent all over, even to Melbourne, Australia, where the theaters have been closed because of the epidemic there too. As a precautionary measure the New York City Health Department has its nurses making house-to-house canvasses. Other acts of prevention are the nightly washing of streets in the infected districts, the exclusion of all household pets from sick rooms, careful screening from flies and insistence upon the utmost cleanliness.

He Has Heard That His Safety Depends Upon Keeping His Surroundings Clean and He Looks as if He Means to Do It

It is the belief that the disease was introduced from Southern Italy by immigrants fleeing from the war zone. The first cases reported in New York City were in an Italian section near the Brooklyn waterfront, where the epidemic of 1907 first appeared. Then the mortality was approximately five per cent; the present rate is about twenty per cent. In 1907 the victims numbered two thousand five hundred.

What makes the situation the more serious is the fact that medical science does not know how the disease is carried. In scarcely one case out of eight hundred has it been possible to trace the source of infection. A few years ago it was announced that the stable fly transmitted the malady. But in Buffalo, during an epidemic, this theory was disproved when districts thick with flies were comparatively free from the disease.

Formerly extreme dryness and heat were given as a cause. However, the Buffalo plague occurred during an unusually wet summer. In an epidemic on the Pacific Coast it was discovered that coincidentally there was an outbreak of lame colts. The two could not be connected, however. Deputy Surgeon W. C. Rucker of the United States

Parks, Playgrounds and Recreation Piers Where Children Congregate Are Closed and Families of Children Are Segregated as Much as Possible in Their Own Districts

Keeping Clean Is Equivalent to Keeping Cool and the Street Gamins Thoroughly Approve of the Idea of Frequent Baths

Health Service, states that in Cincinnati he saw paralyzed chickens and ducks around homes in which were infantile paralysis cases, but again there was no way of connecting one type of victim with the other.

At present the tendency is to attribute the disease to dust germs. When infected with particles of dust found in the rooms of paralysis victims monkeys soon die. The Rockefeller Institute is now carrying on elaborate experiments along this line, and there is some hope that the mystery may yet be solved. Fifty thousand dollars in one cash prize awaits the man who solves it.

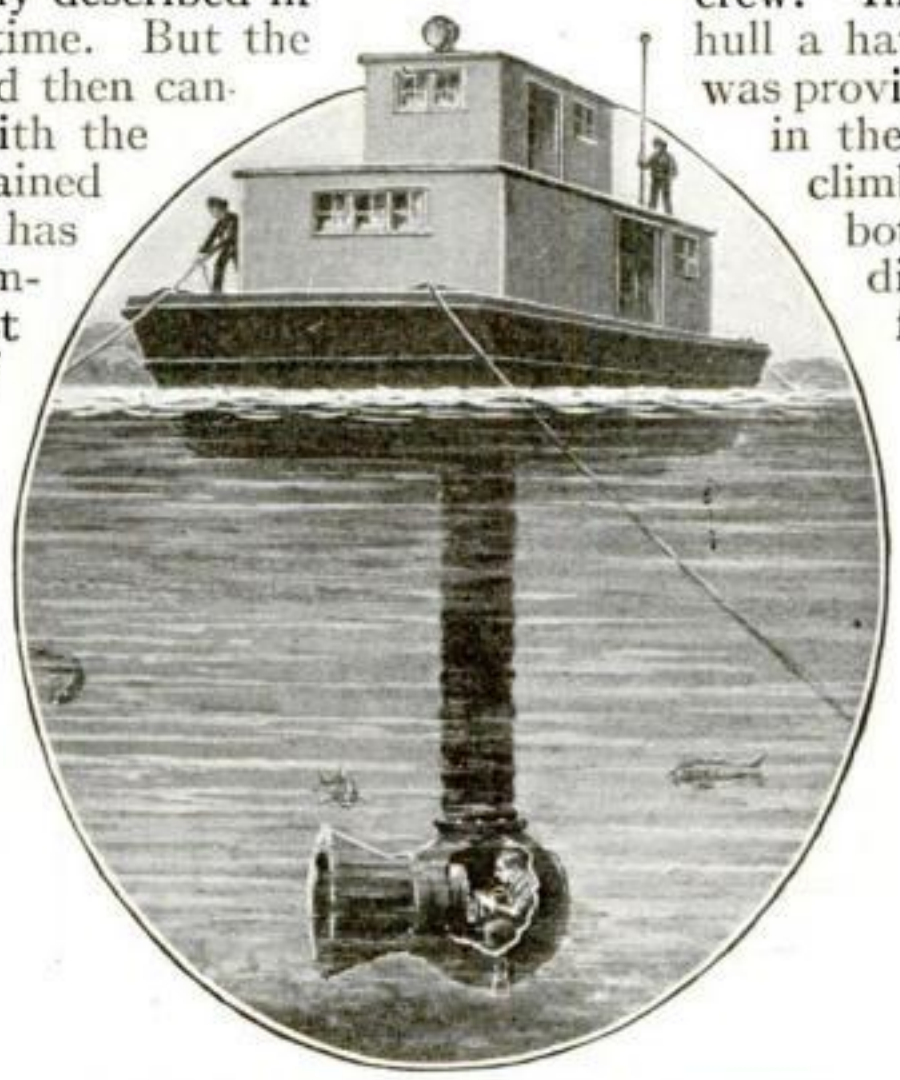
Dr. Flexner, who has succeeded in isolating the organism of infantile paralysis, says it is an infectious and communicable disease which is caused by the invasion of the central nervous organs—the spinal cord and brain—of a minute, filterable micro-organism which has now been secured in artificial culture and as such is distinctly visible under the higher powers of the microscope.

"The virus of infantile paralysis," says he, "exists constantly in the central nervous organs and upon the mucous membrane of the nose and throat and of the intestines in persons suffering from the disease; it occurs less frequently in the other internal organs, and it has not been detected in the general circulating blood of patients."

Staging the Celluloid Thriller

By George F. Wörts

GOING to the bottom of the sea for motion-pictures was accomplished for the first time about two years ago by George and Edwin Williamson, brothers who invented and perfected an undersea motion-picture apparatus. Their apparatus for making photographs under water was fully described in these pages at the time. But the results they obtained then cannot be compared with the results they have obtained in a photo play which has been in process of filming during the past year in the waters of the Caribbean near Nassau, Jamaica.



It Will Be Recalled That the Williamson Apparatus Consists of a Collapsible Tube Suspended from the Bottom of a Barge

Jules Verne and Daniel Defoe on the Screen

They took a most difficult subject for their scenario. It was a composite story based on the most usable parts of Jules Verne's "Twenty Thousand Leagues Under the Sea" and Daniel Defoe's famous "Robinson Crusoe."

When the picture was first contemplated, Stuart Paton, the director, thought that he would borrow a submarine from the United States Navy for the parts of the story in which Jules Verne describes the submarine. The United States Navy was not especially enthusiastic about lending a submarine, and it was discovered that Jules Verne's submarine had very little in common with the submarine of to-day.

Accordingly a submarine was built especially for the picture. It took six months to build, and when it was finished it could dive, rise to the surface and shoot a regulation torpedo. The deck of this unusual craft had one hatch and a very stunted conning tower. In shape only did it resemble the U-boat of to-day. It was engineless. It was submerged by means of inlet valves, and it came to the surface by forcing out the water with compressed air which was carried in tanks. Thirty men comprised the crew. In the bottom of the hull a hatchway (an air lock) was provided, so that the crew in their diving-suits could climb out upon the ocean bottom. The maximum diving depth was about forty feet.

The ocean and its inhabitants provided a great deal of excitement and danger. Most of the time the ocean was rough, too rough for taking pictures. Most of the dramatic action of the film took place on the ocean floor of the Caribbean at a depth of about thirty feet. The water near Nassau was found to be so clear that artificial lighting was not necessary. In the older Williamson undersea picture artificial lights were frequently needed. Since then, however, the apparatus has been considerably improved, and faster camera lenses have also been found.

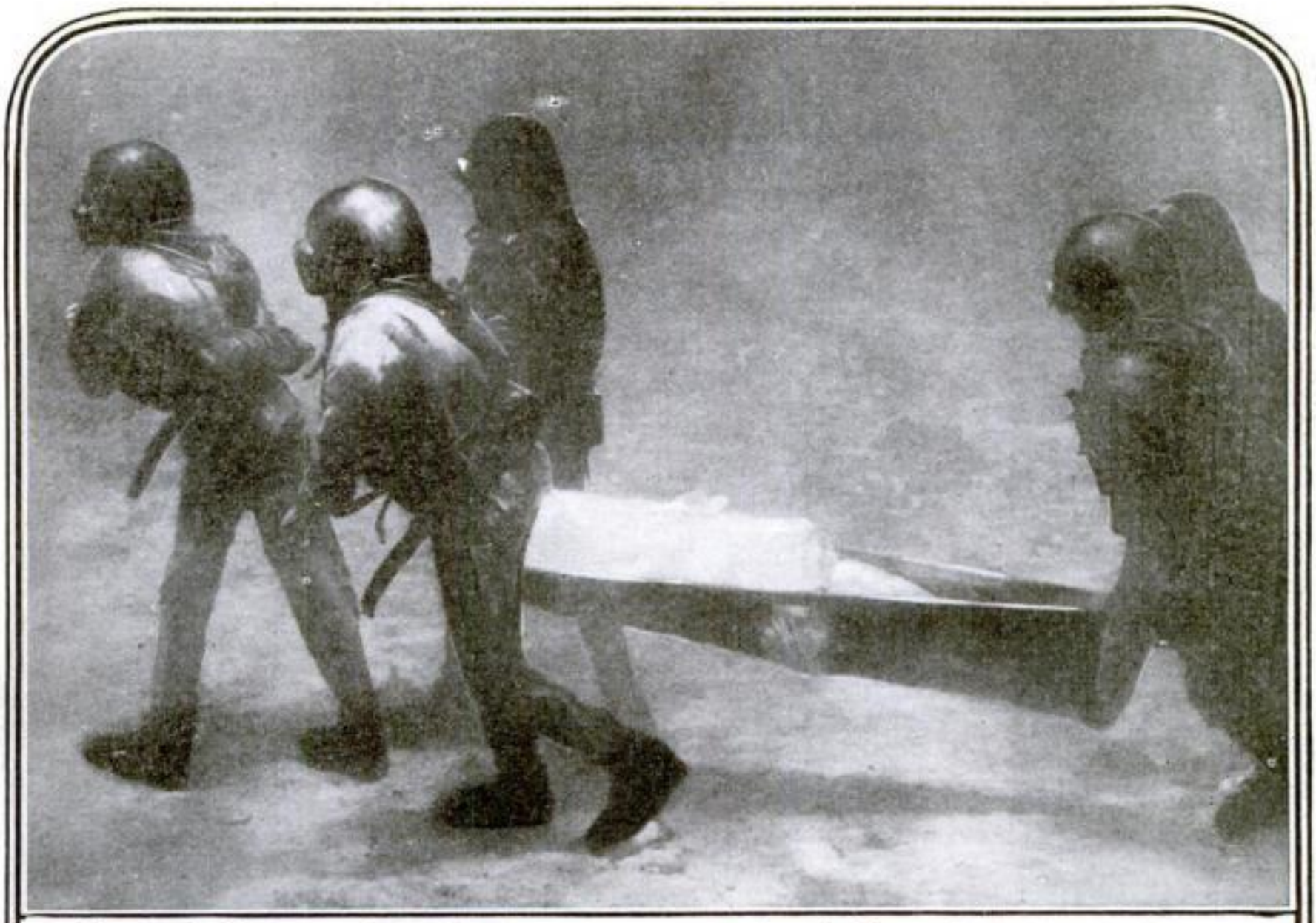
The Williamson apparatus, it will be recalled, consists of a large collapsible tube suspended from the bottom of a barge. At the bottom of the tube is a camera chamber provided with a window. The camera-man sits with his camera behind this window. In rough weather the barge would roll and the chamber and its occupant would swing back and forth. This motion of course prevented picture-taking. The tides furnished another serious handicap. On

Twenty Thousand Leagues Under the Sea

The Twentieth Century Submarine Has Little in Common with the One Jules Verne Imagined; So Six Months Were Devoted by the Wonderful Motion-Picture Magicians to Perfecting One (Illustrated Above) to Fit into the Scenes of the Story. When Finished It Could Dive, Rise to the Surface and Shoot a Regulation Torpedo. It Carries a Full Crew of Thirty Men

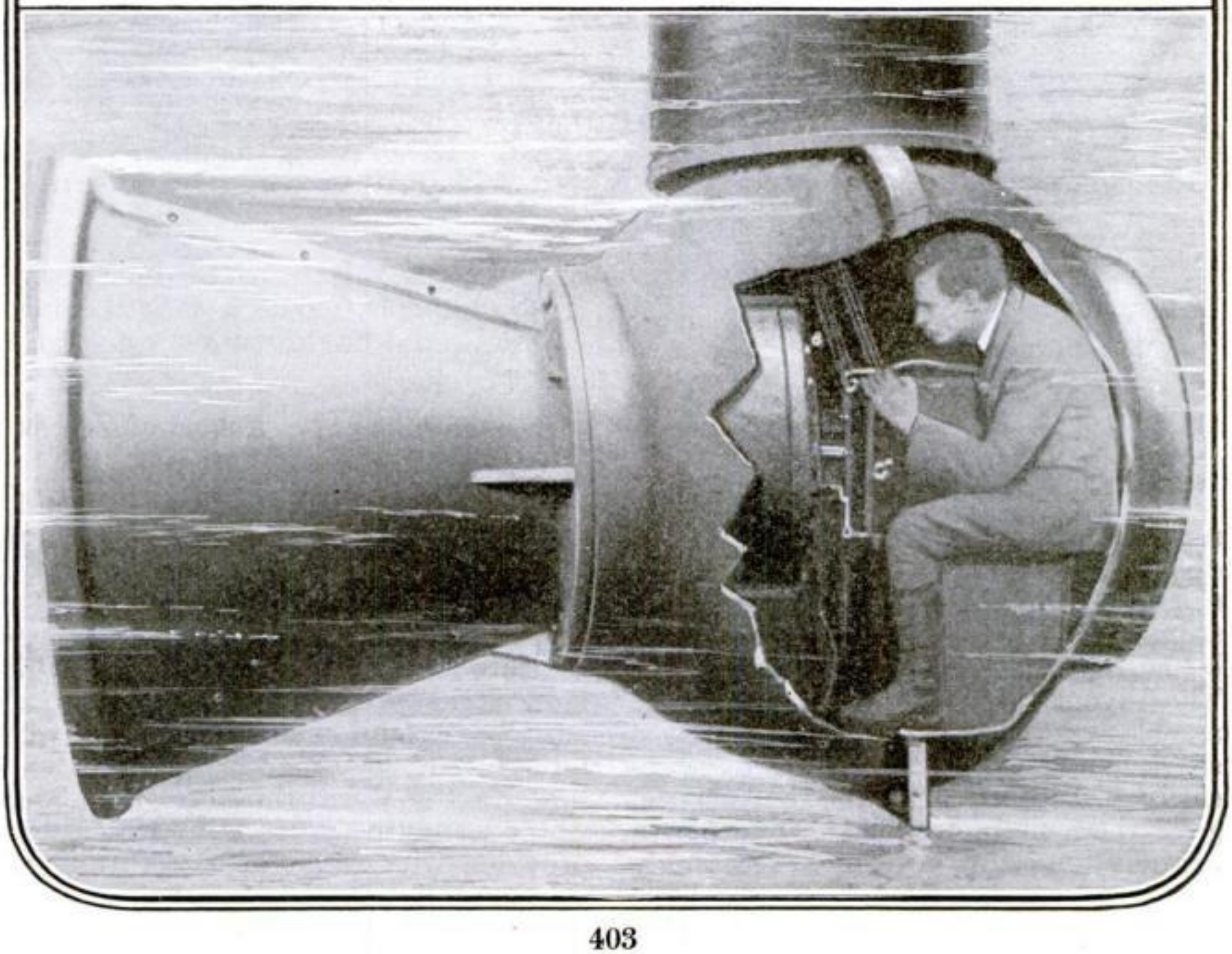
In the Bottom of the Hull of the Barge a Hatchway Is Provided, So That the Crew in Their Diving Suits May Lower Themselves to the Ocean Bed. In the Illustration a Diver Is Shown Returning to the Submarine by Way of the Hatchway. Note How Little His Self-Contained Diving Suit Impedes His Movements Owing to Its Very Light Weight

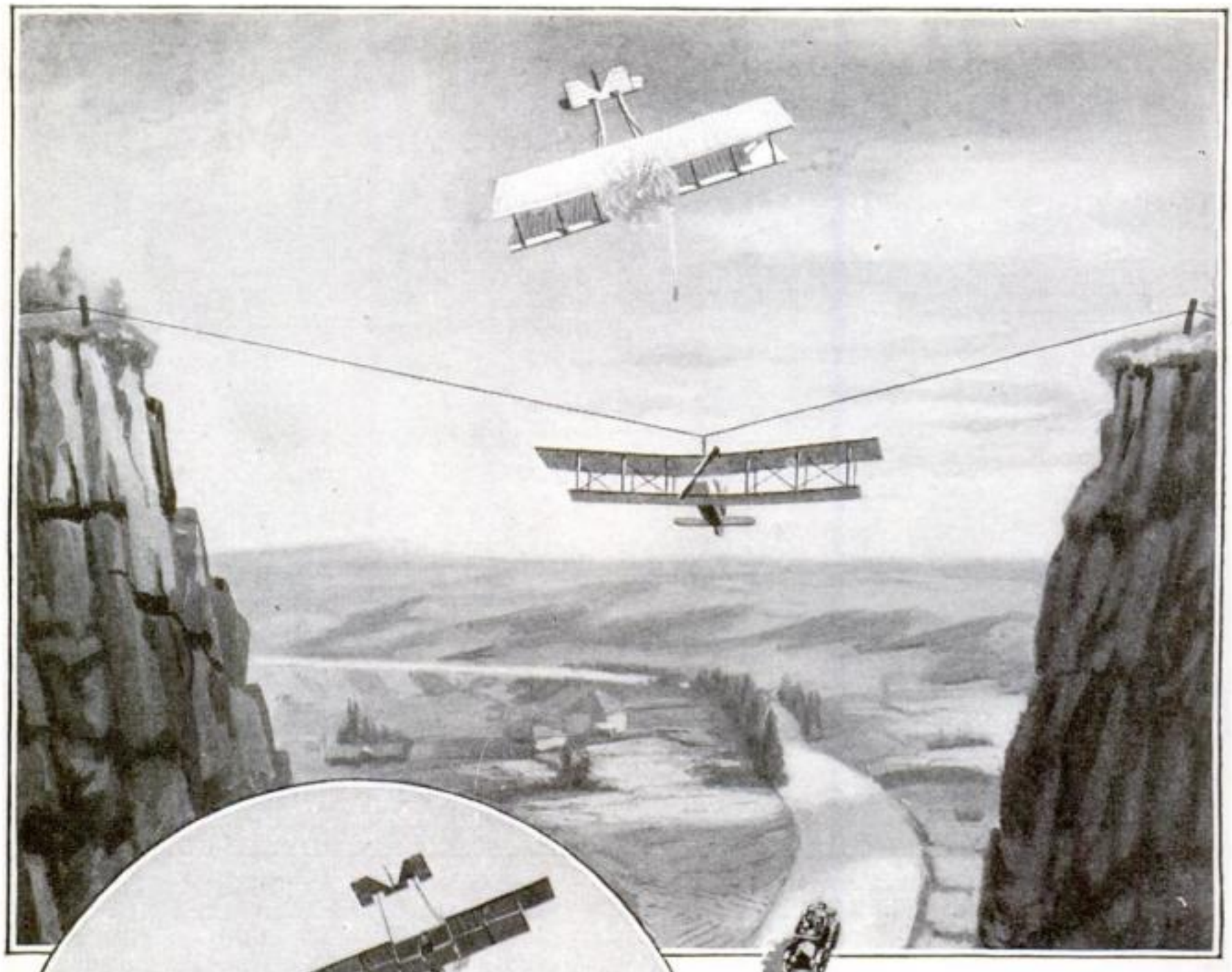
Staged at the Bottom of the Ocean



Above, the Gruesome Spectacle of a Burial at the Bottom of the Sea. The Actors Were Provided with Tanks of Oxygen and Air Enough for Thirty Minutes

Below is Shown the Williamson Cinema Apparatus Which Has Been Greatly Improved Upon Recently by the Inventors to Present a New Photo Play





The Lower Plane Was, in Reality, Stationary, Being Suspended by Strong but Invisible Wires Between the Two Cliffs. The Upper Machine Swooped Down on the Lower One in Mid-Air, Dropped a Bomb Upon It and Destroyed It

many occasions the actors in their heavy diving-suits were swept out of the camera's range. Other dangers not stipulated in the scenario were provided by curious and investigating giant fish. The divers succeeded in breaking one age-old tradition. They found that a shark could be frightened away very easily. Another fish, the barracouta, gave them more trouble. The barracouta is long, slim, swift and exceedingly vicious. Barracouta in swarms, or schools, would attack the men, and could be driven away only after a fierce battle.

Love-Making at the Bottom of the Sea

Not only were fights with barracouta and fights between men staged on the ocean floor, but many of the dramatic events of the story took place there. A rubber-clad hero wooed his rubber-clad heroine. A burial took place, and treasure was hunted and found. In fact, as many of the features of Verne's story as could be consistently were reproduced.

The actors were dressed for the underwater scenes in diving-suits, which were provided with tanks of oxygen and air

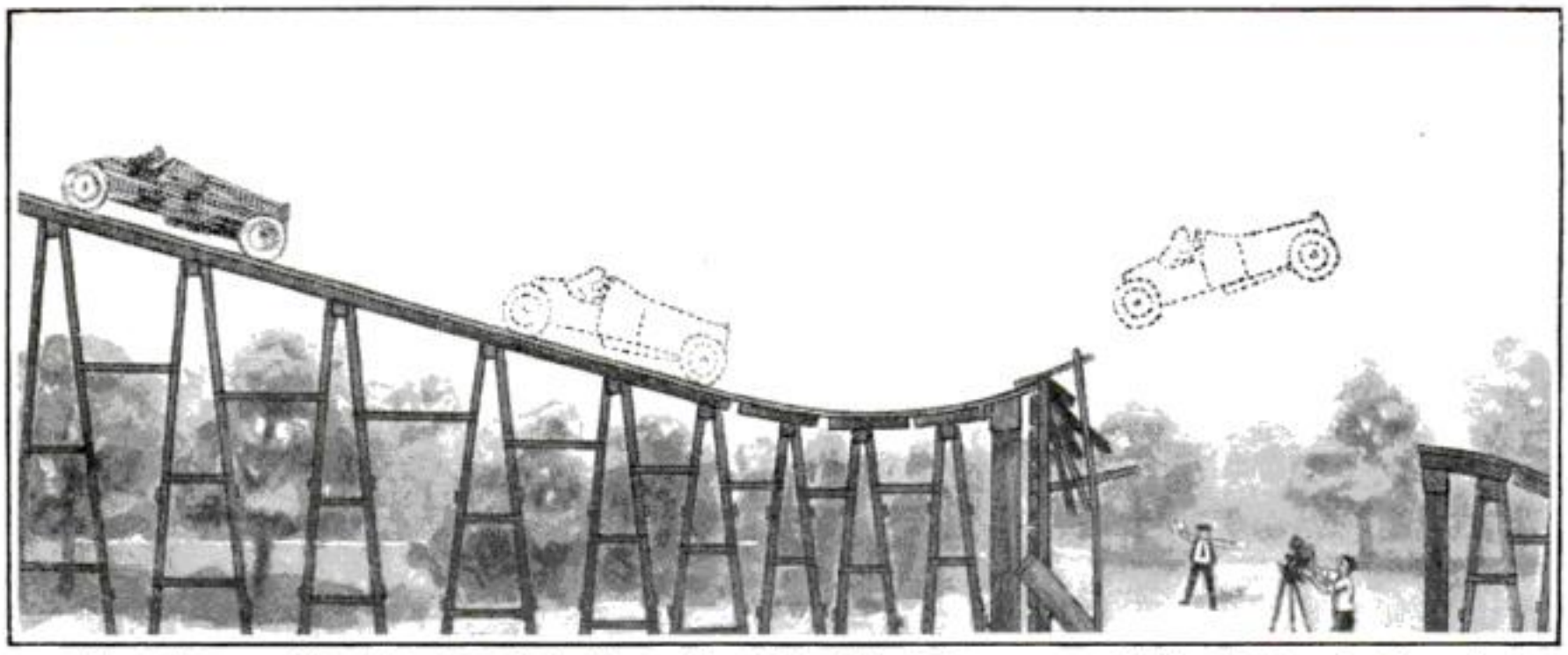
The Camera-Man Being Directly Under the Hurtling Car, Caught It As It Flew Through the Air. It Came Near Crashing Down Upon Him and a Gathering of Curious Ones, But the Heroine Was Unhurt. Why? For the Good Reason That She Wasn't There

sufficient for thirty minutes' work.

Perhaps the most familiar thrill which finds its way through the flickering lens is the automobile smashup. One of the most thrilling feats in which automobiles have figured on the screen this year took place in California recently, when a motor-car in which the heroine was hastening to her hero, speeded over a broken bridge and leaped through the air to the ground seventy-five feet away. There was really danger in this picture; danger, not for the heroine, but for the man who was turning the camera-crank. The bridge was carefully smashed up previously and the central part taken out. The approach was built up much after the fashion that ski runways are prepared in order that the skiiers will fly into the air when they strike the runway.

In the picture as it appeared on the screen, the girl dashed down the roadway, unaware of the fact that the bridge was destroyed. Indeed, she drove the car at high speed almost to the approach. In the mind of the audience, that car kept on going, with the girl inside, and leaped the gap. In reality, she got out of the car when she had stopped it at the bridge approach. Then the car was backed up a considerable distance down the road, it was pointed, or aimed, directly at the bridge and the steering wheel locked so that the car would not swerve. It was started—gained speed, dashed out upon the bridge, hurtled over the gap and came crashing down to earth very much broken up. The camera-man, being directly under the hurtling car, caught it as it flew, meteor-like, through the air. And it nearly crashed down upon him!

The car flew seventy-five feet. It just happened to alight right side up, so that the girl might just as well have stayed in. But that would have been contrary to the new code of thrills which the industry (shall we say "art?") has adopted—Let thrills be as they may—safety first.



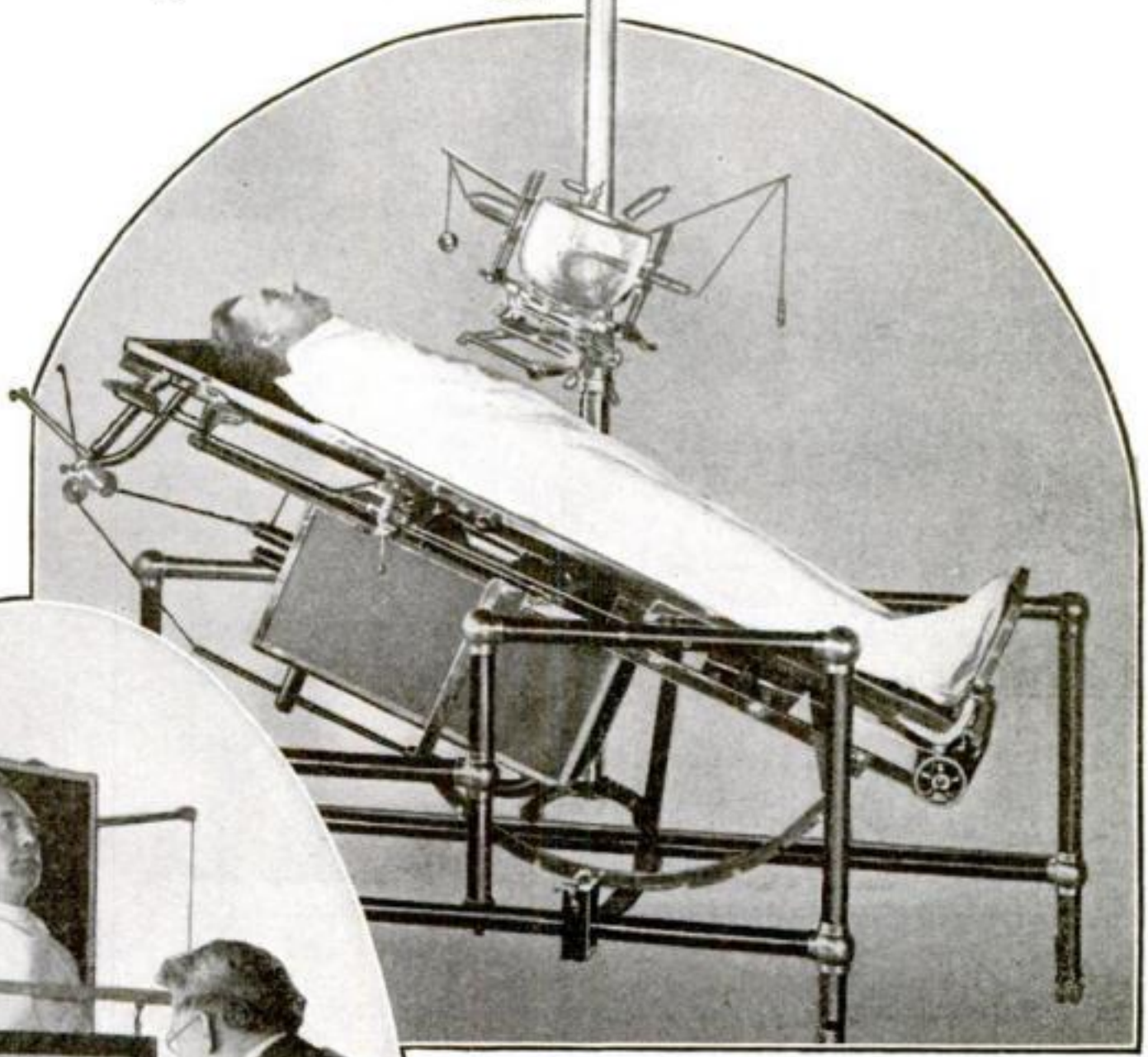
The Automobile Was Backed Up a Considerable Distance and Was Pointed Directly Toward the Gap, After Which the Steering Wheel Was Locked and They "Let Her Go!"

Sacrificed to Make a Motion-Picture Holiday

A motion-picture company recently "staged" a costly picture in which one aeroplane swooped down upon another in mid-air, dropped a bomb and destroyed it. While the lower plane which was two hundred feet above the ground, seemed to be moving at a fairly high speed, in reality it was stationary, being suspended by strong but invisible wires between two cliffs. It seemed to move because the movie camera was mounted on an automobile which was moving rapidly below it. The narrow focus of the camera lens prevented either of the cliffs from being shown.

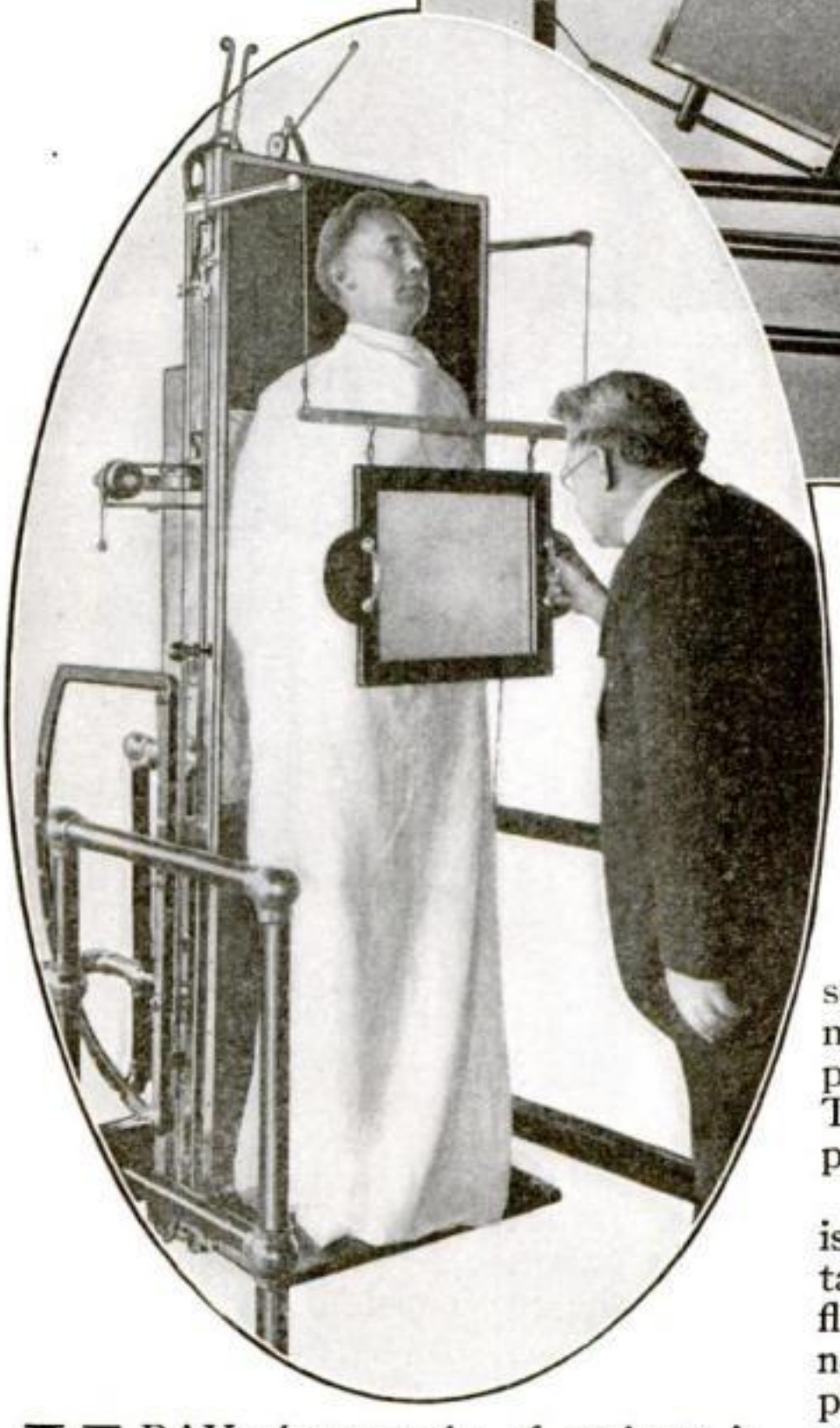
The feat is interesting also for a tragic reason. When the airman in the upper plane dropped the bomb, he was directly above the destroyed plane. The explosion forced an air wave upward which unbalanced the moving plane, it toppled over and the aeronaut was crushed to death in his fall.

An X-Ray Tilting Table



After the Patient Is Once on the Table He Remains There Until a Complete Examination Has Been Made and Radiographs Taken

At the Rear of the Table There Is a Tube Carrier Which Moves Automatically with the Screen at Which the Physician Is Looking

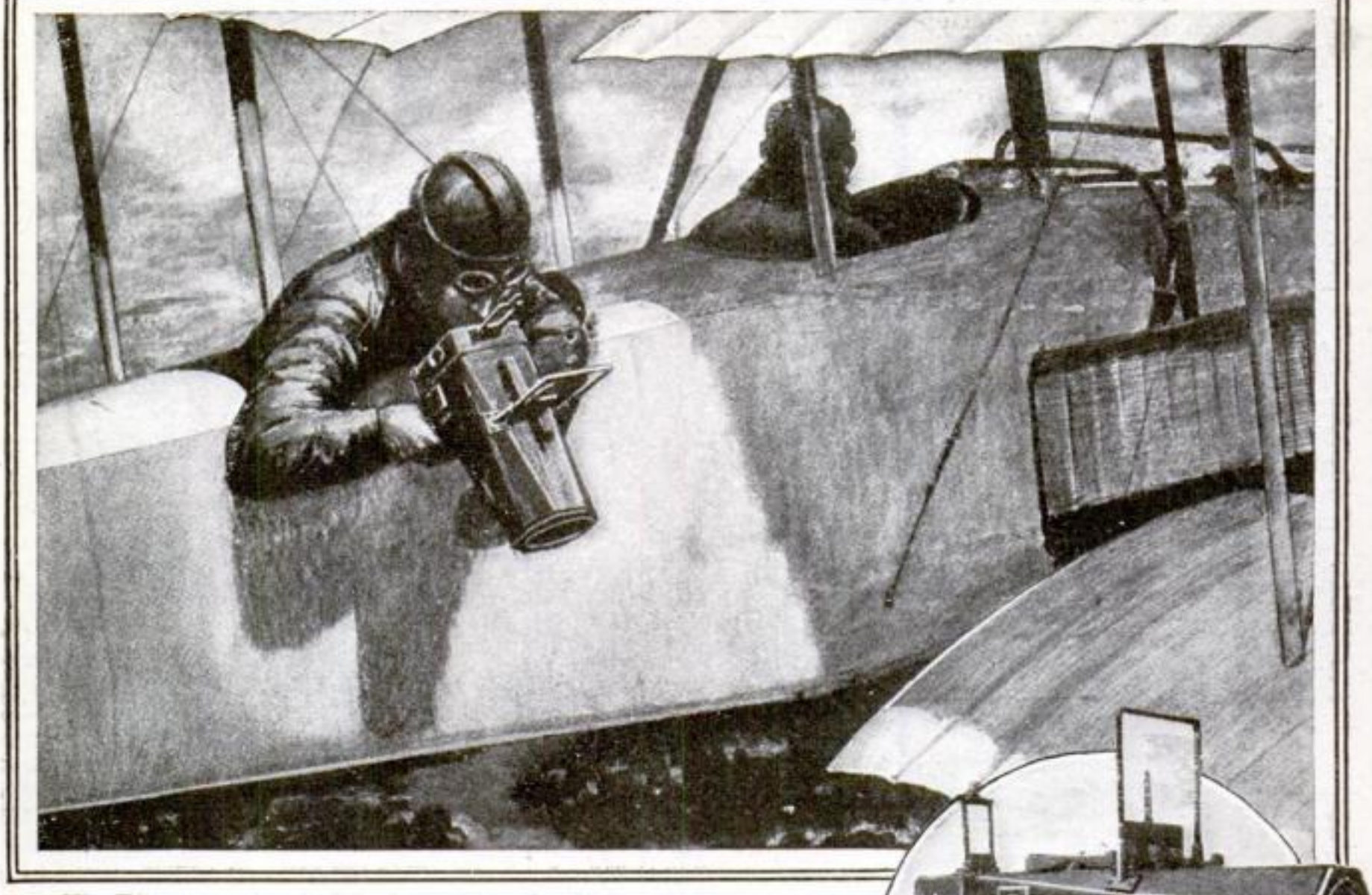


X-RAY photographs of patients in all possible positions to suit the various conditions with which the physician or surgeon has to deal are made conveniently with a "tube tilt-table," invented by Claude E. Campbell, of Lynn, Massachusetts. The device combines in one compact mechanism several pieces of apparatus.

One of the accompanying photographs shows the table as used for fluoroscopic examination of the patient, who is standing between the fluoroscopic screen and the table. At the rear of the table is a tube carrier which moves automatically with the screen at which the doctor is looking, making it possible to examine the patient's trunk without moving him. The patient and the operator are protected from the X-Ray.

In the other illustration, the patient is shown on a table tilted down for taking an X-Ray photograph. For the fluoroscopic examination, the screen—not shown in this picture—would be placed over the patient. For making a radiograph the plate would be placed under the patient and the current thrown in the tube holder above the patient.

The table can be tilted and locked at whatever angle may be most convenient.



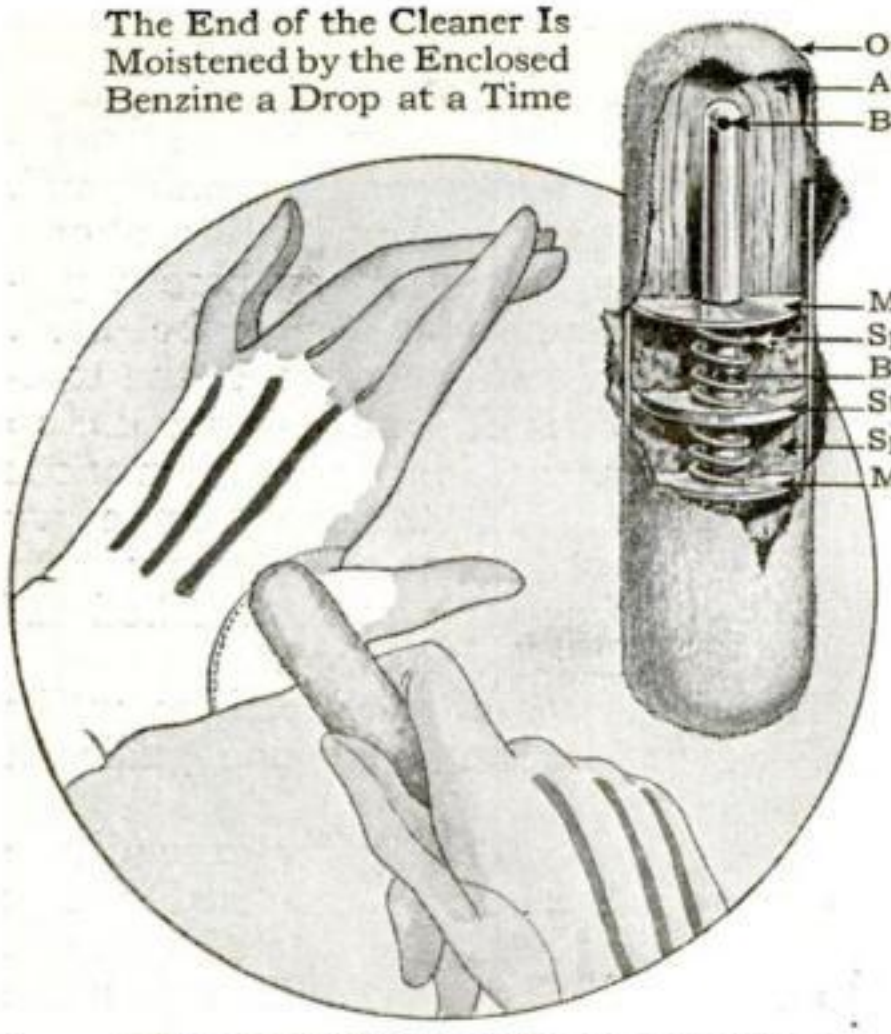
The Photographer in His Aeroplane Can Point the Pistol-Camera with Great Accuracy at the Object To Be Photographed. The Two Focusing Frames Take the Place of Sights on a Revolver. The Trigger Operates the Shutter

"Shooting" a Photograph with a Pistol-Camera

OF the number of aerial cameras which have been designed to meet the requirements of modern reconnaissance work in the present war perhaps the most novel and interesting apparatus is a pistol-camera used by German airmen which is now in the possession of the French. Jean Navarre, a daring young French flier who brought down his fourteenth German aeroplane early in April, found the camera in an Aviatik which he forced to descend within the French lines in the Soissons neighborhood.

The camera was intact and in working order. In fact, there was reason to believe that it had been used the same day it fell into the hands of the French, although no plates were exposed. Several were in position, however, ready to be exposed. The pistol-camera has the shape of an enormous pistol, and looks unwieldy because of its large size and grotesque shape. It has a pistol grip and trigger similar to that on all makes of revolvers. The shutter of the camera is operated by pulling the trigger. The photographer points the apparatus with dead accuracy at the object to be photographed and with a slight movement of his finger takes the picture. The two focusing frames, which are nothing more than common gun-sights in disguise, enable the photographer to level his camera with absolute certainty.

The length of the camera box is a little under two feet, and its weight about thirteen pounds. The French have tested the photographic capabilities of the apparatus by experimenting with it in their own aeroplanes. Excellent results were produced. In some cases clear and distinct photographs of military value were taken at altitudes of upwards of six thousand feet. This camera is the only one of its kind to fall in the hands of the French.



Cleaning Gloves Economically with Benzine

A GLOVE cleaner which contains its own benzine is illustrated. A metal tube holds a sponge in its upper part and felt or some other porous material in its lower part. The whole is surrounded by a covering of fabric.

The device is pressed down on the glove. This drives in the felt and pushes down the disk, compressing the sponge and causing liquid to pass through a small hole into the tube and out through a second hole. In the middle there is a fixed metal piece which separates the device into two similar halves. Two strong springs separate the parts.

Good-By to the Pin-Boys in the Bowling-Alley

A NEW kind of bowling-alley has been invented by Joseph M. West, Rockport, Missouri. The bowler throws a ball suspended from a trolley carriage which travels on an elevated guide-rail. It is merely necessary to pull a lever to cause a resetting ring to push the pins back into upright position. The ball is automatically returned to the bowler without the services of the pin-boys. A perfectly accurate floor, the expensive feature of an alley, is not essential.

The Ball Is Suspended from a Trolley Carriage Which Travels Back on a Guide-Rail

A Perfectly Accurate Floor Is Not a Prime Essential of This Alley

Trilby, of Lincoln Park, Chicago, Gets Her Nails Trimmed Only Once in Six Months, But That Is Enough, According to Her Manicurist, and Too Often for Trilby

When Manicuring Nails Is a Dangerous Job

MANICURING a lion's toe-nails is a man's job, especially when the patron is a man-eating lioness with a recent killing to her discredit. The illustration shows Cy De Vry, head animal man at Lincoln Park, Chicago, cutting the toe-nails of Trilby. A week previous to this Trilby was known as a docile creature particularly attached to her keeper, Emerson Dietrich. In one day her reputation changed from a lioness with a kitten disposition to the most ferocious creature in captivity.

The transformation took place when Trilby was alone in a box-car with Dietrich. With no apparent warning the beast became ugly and attacked the man, tearing at him with such fury that he was unable to beat her off. Before he could summon help the lioness had killed him and had already started in to eat up the car. When Trilby's toe-nails were manicured she raged and fought the men, but a pike pole and a rope soon reduced her to a submissive state.

A Garden Tractor Which Does Everything But Mind the Baby

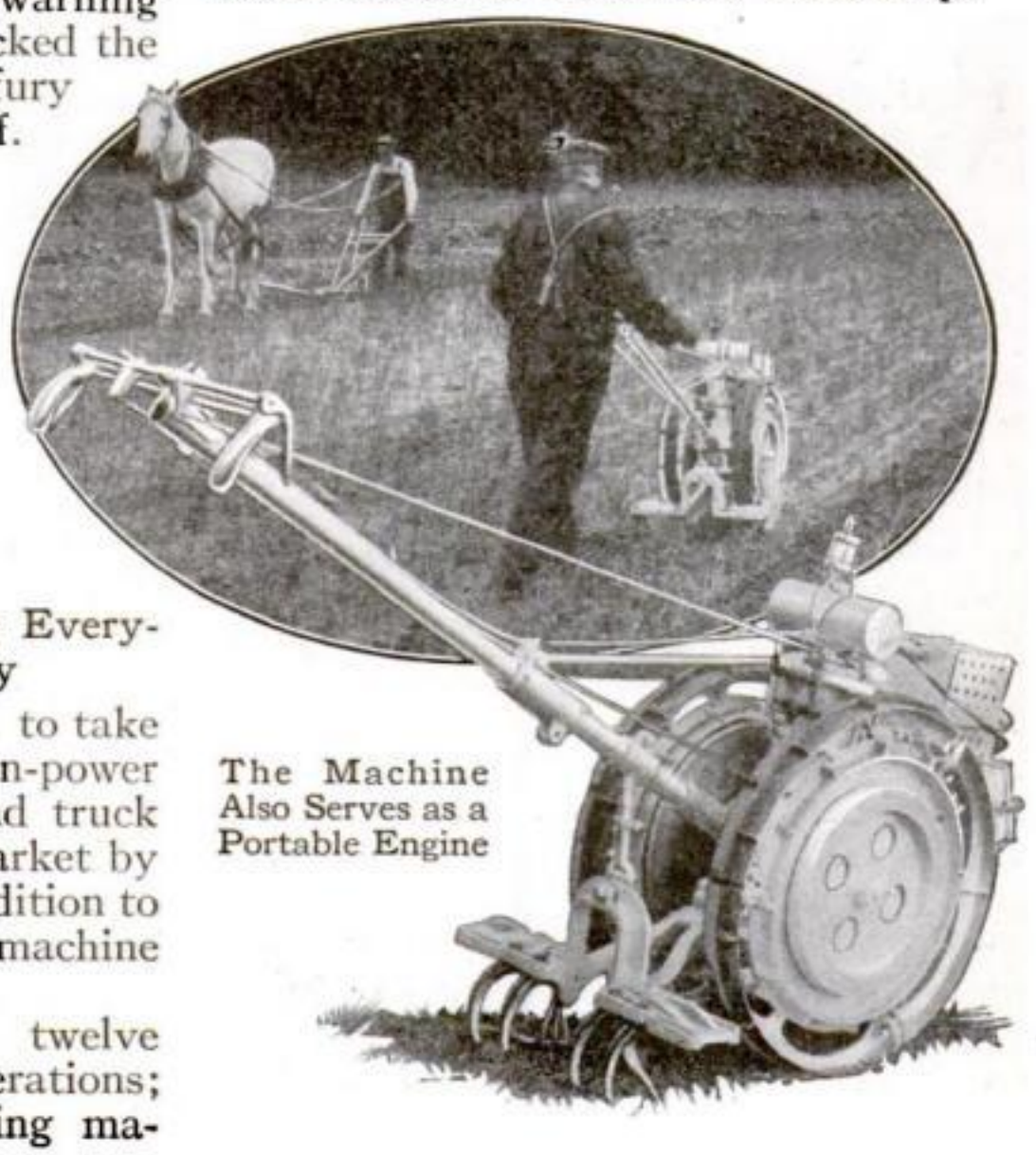
A GARDEN tractor designed to take the place of horse and man-power in the cultivation of garden and truck crops has been placed on the market by a Minneapolis company. In addition to its usefulness as a tractor, the machine also serves as a portable engine.

The machine can perform twelve distinct and widely varying operations; among them, running a washing machine, churning, mowing lawn, running an emery wheel, sawing, operating a cream separator and turning a fanning mill. It can be applied to almost any small task where a gasoline engine may be used. Primarily, however, the tractor is designed for small crop cultivation, in which work it is said to excel in every particular the former and time-sanctioned method of cultivation by horsepower.

The operator of the machine walks behind and steers it as one guides a lawn-mower.

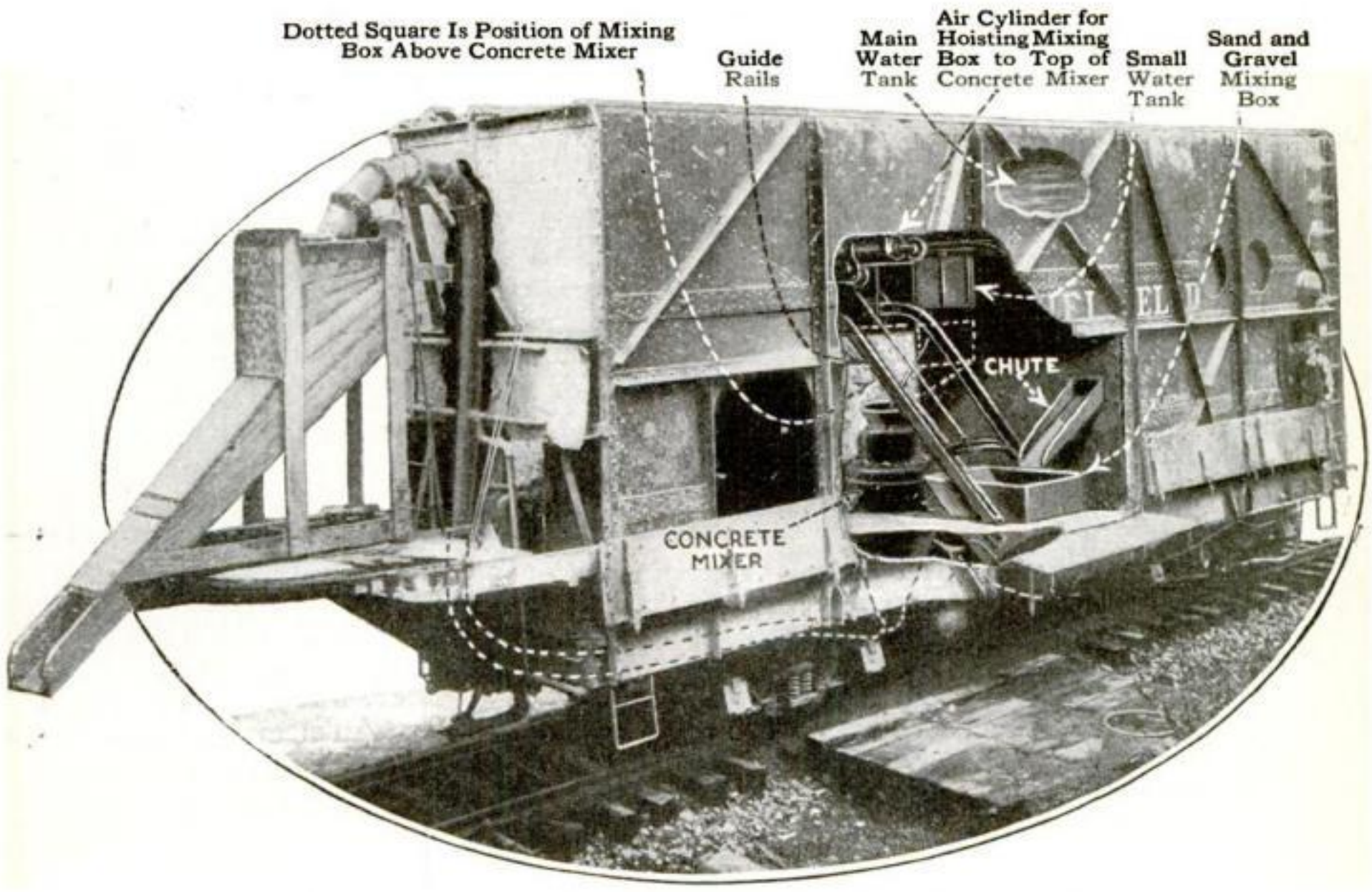
There is no necessity for expenditure of energy in handling the tractor as it pulls itself along at the rate of from one to three miles an hour. The machine is capable of two thousand two hundred revolutions a minute when it is attached to another machine by means of the connecting belting and pulley attachment. It weighs four hundred and fifty pounds and is made especially heavy to insure traction.

The Old and New Methods of Harrowing in the Cultivation of Garden and Truck Crops



The Machine Also Serves as a Portable Engine

Blowing Concrete Into Place



A Specially Constructed Steel Car Which Conveys Concrete at the Rate of Fifty Feet a Second by Utilizing Compressed Air. The Car Propels Itself with the Aid of a Gasoline Equipment

A NEW system for conveying concrete to the place where it is to be used employs compressed air and the concrete travels at the rate of fifty feet a second. It is especially applicable for lining tunnels with concrete. The mixing may be done outside the excavation and the concrete conveyed by a pipe line to the point of use. Or, to cite a recent instance on the line of the Carolina, Clinchfield & Ohio Railroad, the mixing may be done on the spot upon a movable car.

It was desired to put the concrete lining into Sandy Ridge tunnel near Dante, Va., without shutting off the railway traffic through it. The concrete required amounted to some 50,000 or 60,000 cubic yards. A steel car was specially constructed, and provided with a gasoline equipment by means of which it could be made to propel itself. Half way between the ends is located the mixing compartment—open on both sides of the car. At a higher level, extending the whole length of the car, are located the stone bin, the water tank and the sand bin. The water is immediately above the mixer compartment. The two end bins have inclined bottoms sloping towards the mixing chamber where they deliver the sand and the stone by suitable chutes. The gasoline engine is located at one end of the car beneath the sloping bottom of one of the bins. Beneath the sloping bottom of the other bin is placed the air receiver and the bags of cement. When the supply of compressed air runs low, a fresh supply may be taken from an air main running through the tunnel.

The mixing chamber contains two principal pieces of apparatus. One is the mixer itself, placed on one side of the car. The other is the charging skip. Its permanent place is on the other side of the car between the two chutes. When these chutes have delivered their

materials and the cement has been dumped in by hand, the skip is hoisted by compressed air and made to dump its contents into the mixer. Inclined rails guide it from its permanent place to its transient position above the mixer. Compressed air is used to perform the mixing, the conveying and the placing.

The conveying is a short affair. A suitable pipe takes the concrete from the bottom of the mixer beneath the car and up to an elevated position at one end of the car. Here the pipe divides into a Y, associated with which is a sliding plate to control the movement of material into either arm. One arm of the Y is used when placing concrete in the side walls and foundation; the other, when placing it in the arch.

Motor-Trucks to the Rescue in a Freight Embargo

THE great value of motor-trucks for overland haulage was brought out recently when a convoy of five vehicles and three trailers hauled a total load of forty-four tons of steel from the customs warehouse in New York city to a manufacturing plant in Hartford, Conn., a distance of one hundred and forty-four miles. The steel had arrived from Sweden but could not be shipped to Hartford by rail because of the difficulty in obtaining freight cars. The plant was almost out of material and was facing a complete shut-down until a motor haulage contractor in New York city agreed to deliver the goods overland. His convoy, consisting of five 5½-ton motor-trucks and three 5½-ton four-wheeled trailers, left New York at 5 P.M. one night and arrived at Hartford at 11 P. M. on the following night. During the first night the drivers took four hours of sleep apiece, stopping and lying down on the seats of their cabs, for the total load was very valuable and insured for $100,000 by both the consignee and the haulage contractor. If it had not been for the motor-trucks, there is no telling how much the plant would have been inconvenienced.

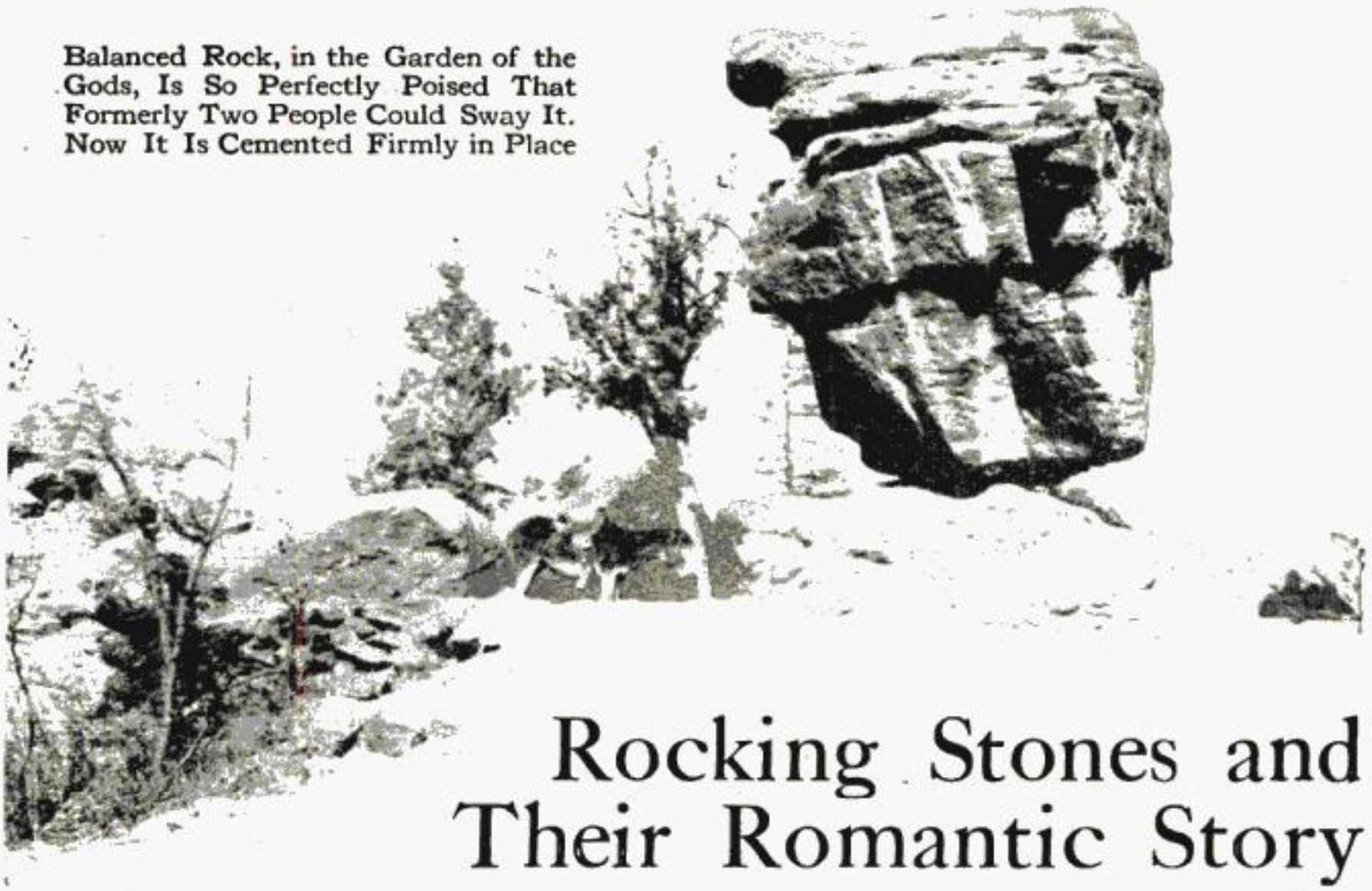
An Electric Motor-Chair

THE electric motor-chair shown in the illustration has such a wide variety of uses that it seems destined to become very popular. It may be used by invalids and by convalescents in hospitals; as a pleasure vehicle on board walks; for trips in the parks; for giving the children little outings; and even for shopping and for a calling car. Its operation is so easy and so nearly fool-proof that there is very little danger of accidents.

The chair develops a speed as high as ten miles an hour, but can be adjusted for lower speeds. An electrical appliance prevents higher speeds when going down hill. The fender serves to prevent serious accidents when running into obstacles; for as soon as it touches an object the circuit is broken, the power shut off, and the brakes automatically applied. The chair is guided and controlled in the same manner as the electric automobile.

It may be elaborated and provided with a wind-shield, top, and side curtains. When fully equipped it weighs about four hundred pounds. The batteries may be charged at any garage or other place where the ordinary storage battery is charged. In fact, except for its style and its fender mechanism, it is very similar to the ordinary runabout.

The Motor-Chair Develops a Speed of Ten Miles an Hour



Balanced Rock, in the Garden of the Gods, Is So Perfectly Poised That Formerly Two People Could Sway It. Now It Is Cemented Firmly in Place

Rocking Stones and Their Romantic Story

IN some of the accompanying photographs are to be seen three different kinds of rocks, perched by Nature one on top of another. How could they have been placed in such positions? They weigh many tons.

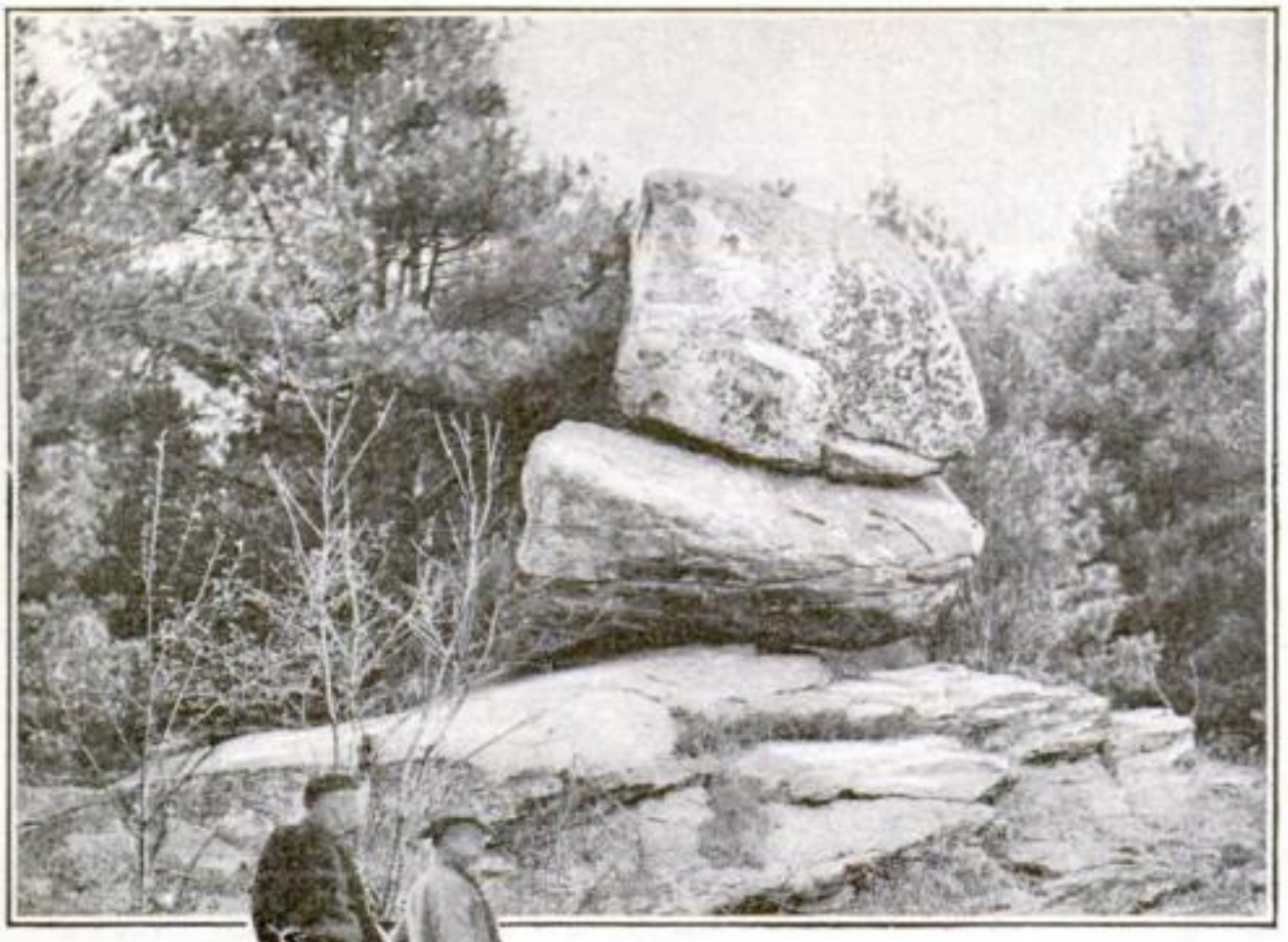
Millions of years before the coming of the first man on the earth, the two top detached boulders were gently placed in their present resting places by the hand of a veritable giant—the North American glacier. During the Great Ice Age the whole of the northern portion of the United States was covered hundreds of feet deep with glacial ice. A glacier is snow, which, by melting and intense packing, is formed into solid ice banks. But the glacier is a constantly moving ice mass. It travels slowly but with enormous grinding and carrying power, down the slopes and valleys.

A mass of ice several hundred feet thick, constantly replenished at its source, and sliding down a mountain slope with a weight of many tons to the square foot must have been well-nigh irresistible. That such was the case is illustrated by the many enormous boulders which were picked up from their original moorings by the huge glaciers of the Ice Age and transported many miles before they were deposited by the melting of the ice.

Without this now well established explanation of glacial transportation it would be impossible to account for the queer positions in which boulders are often found as well as for the intermingling of entirely different kinds of rocks in the same place.

In one of the photographs the upper boulder is a rock about five by eight by eight feet, of coarse Massachusetts granite. It is securely perched on a different kind of rock of nearly the same size—a rock known as a gneiss. Both are resting on a granite ledge, but of a different texture from that of the upper granite rock. Even assuming that the two granite rocks were alike, without knowledge of glacial action, it would be difficult to account for the presence of the middle boulder weighing at least ten tons.

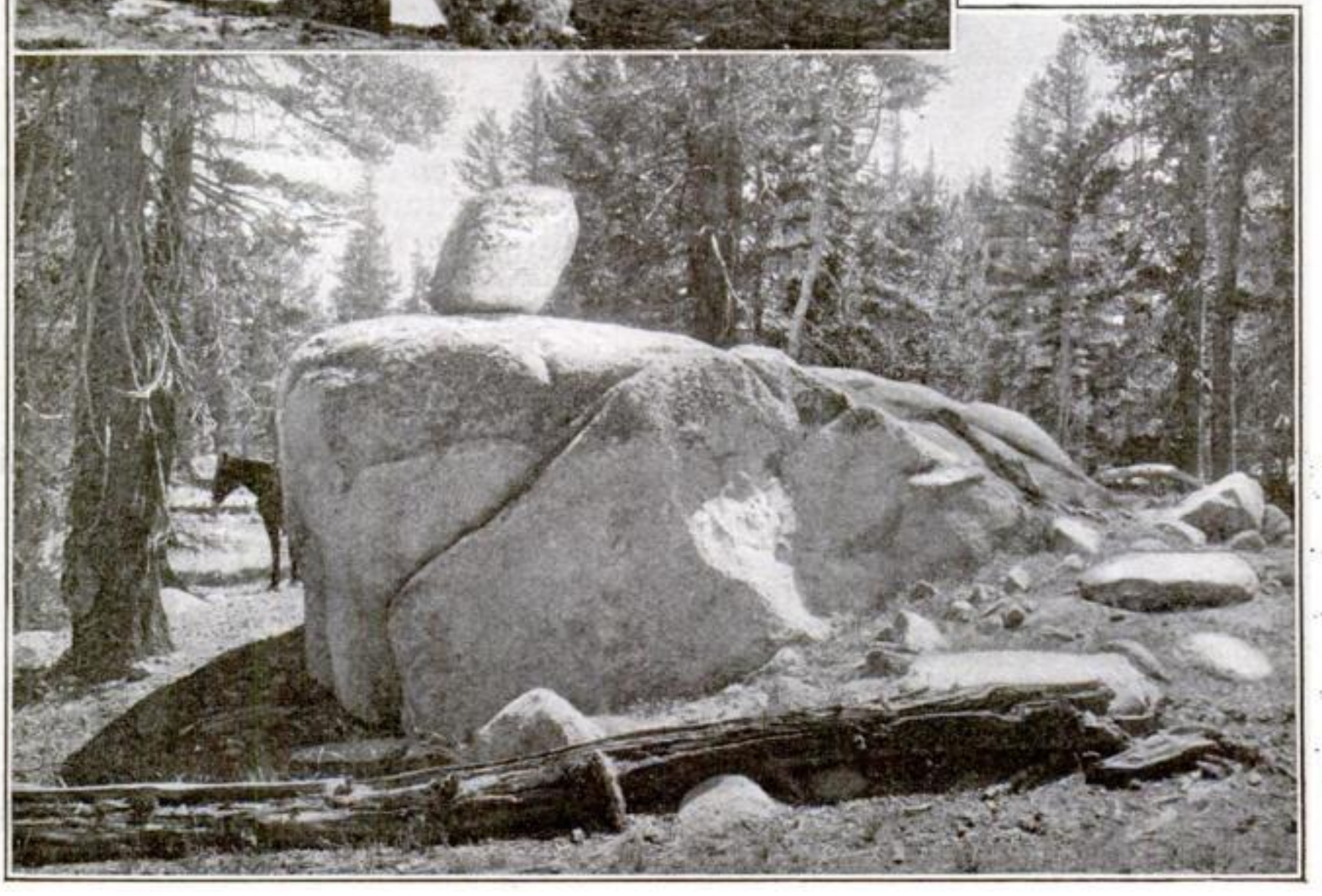
Nowhere in the United States are the evidences of the tremendous force of the great glaciers of the Ice Age more striking than in the Sierra Nevada of California. Rugged V-shaped mountain gorges have been scoured and smoothed out into broad U-shaped valleys by the great descending ice masses. The dirt and rocks have been spread about on the plains below or at the mouths of the canyons, while the glacial scratches and furrows can be plainly seen on the remaining rocks in

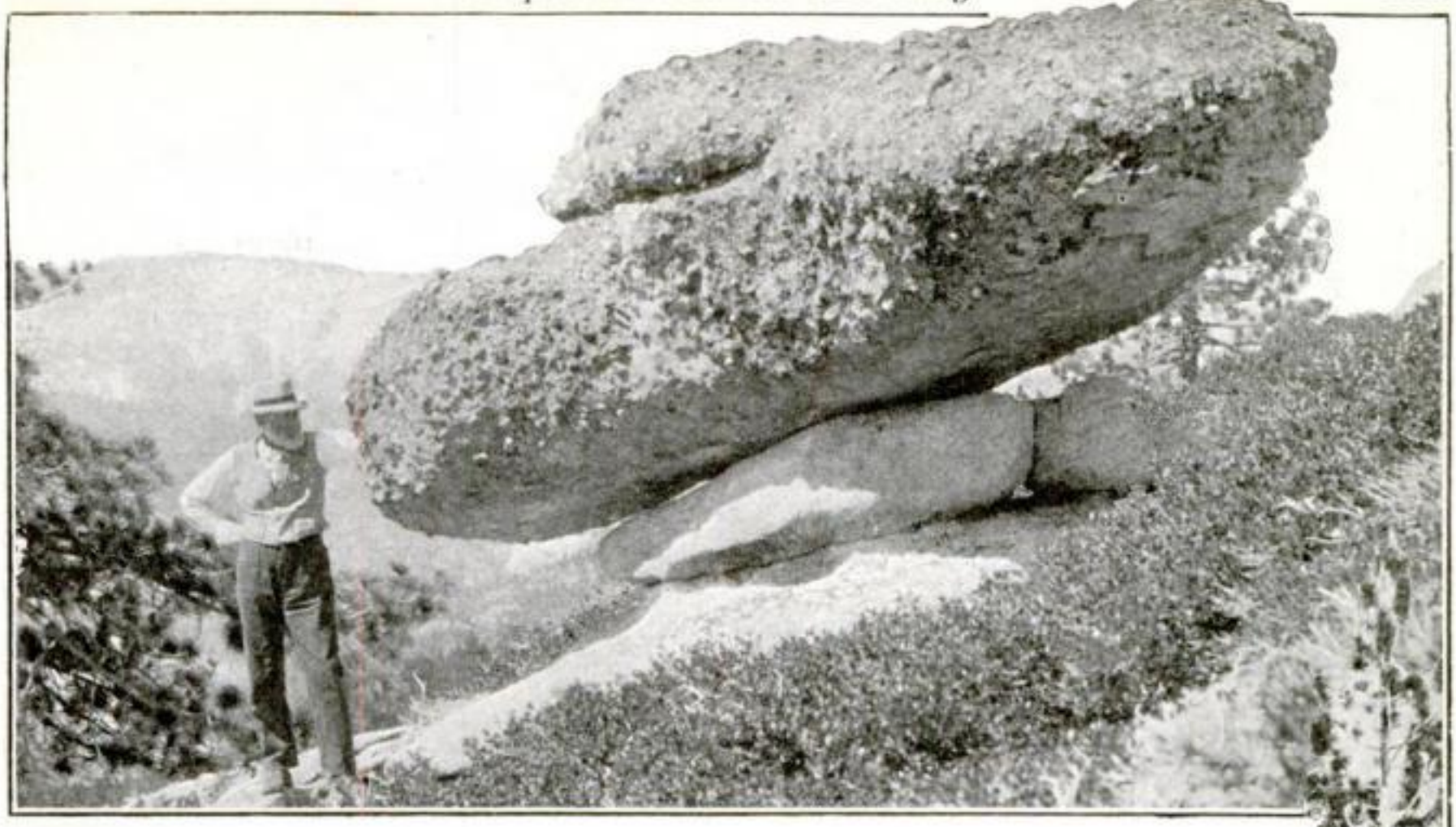


The Upper Boulder Is of Massachusetts Granite. It Is Resting on a Rock of Gneiss, and Both are Perched on a Granite Ledge of Different Texture From That of the Upper Granite Rock

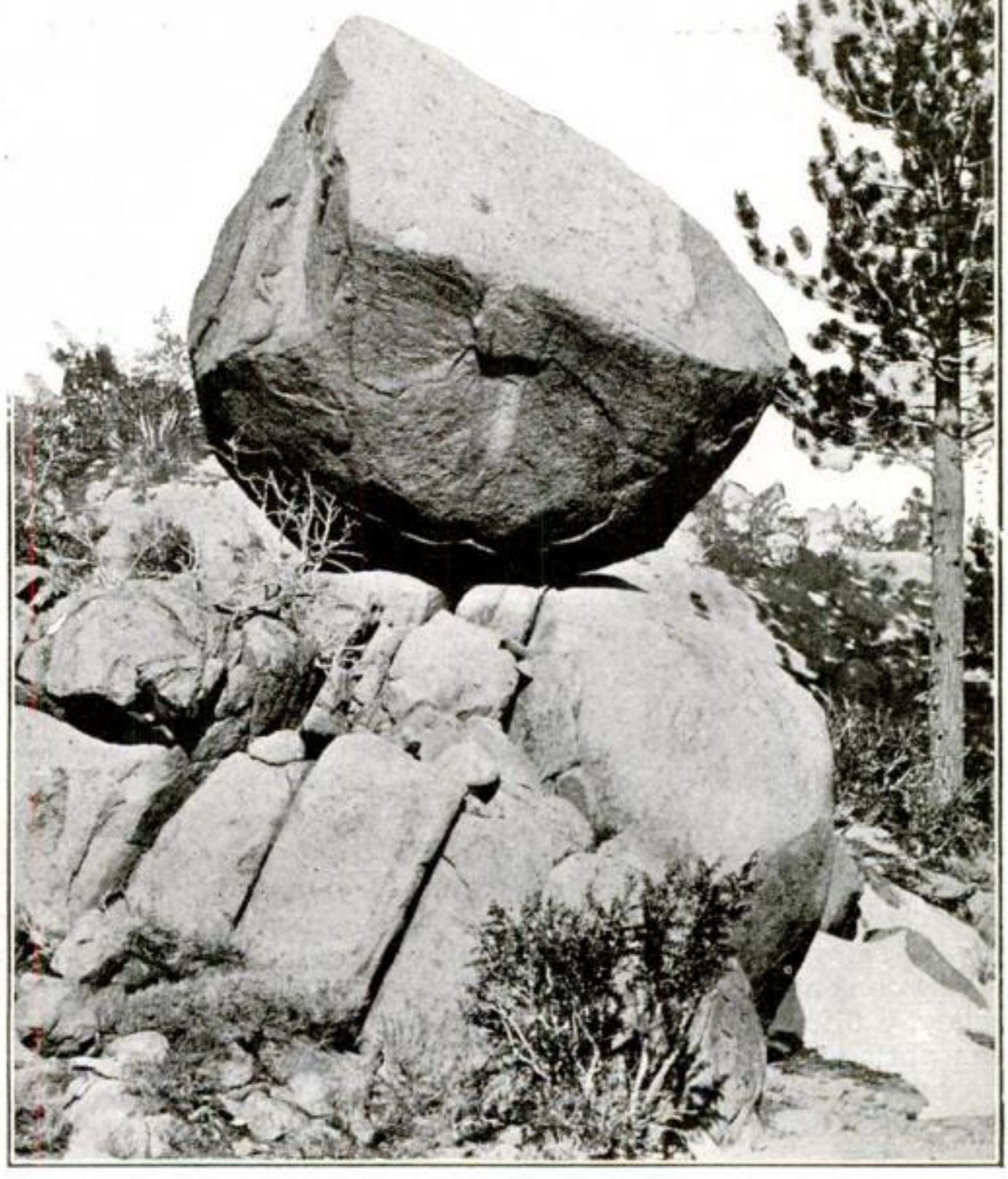
At Left Below, A Rock Transported and Deposited by Huge Glaciers from the Sierra Nevada. This Rock will Outlast Its Base Many Thousand Years

Below, An Erratic Rock Fragment Resting on a Big Base, Brought to Its Present Position by an Agency Powerful Enough to Transport It Over Irregularities in Land Surface





Above, A Perched Granite Boulder Left on a Sandstone Base by a Glacier Which Melted on a Slope of the Famous Yosemite Valley, California. The Sandstone Pedestal Is Greatly Weathered and in a Hundred Thousand Years, Perhaps, It Will Wear Away and Precipitate the Heavy Boulder Into the Canyon Below



At Right, The Large Boulder Which Serves as the Base Is Rapidly Wasting Away While the Smaller Boulder on Top of It—Weighing a Ton or so—Shows No Signs of Deterioration, Although It Has Probably Rested in This Position For the Better Part of a Thousand Centuries or More

The photograph with the man standing beside a rock shows a perched granite boulder left on a sandstone base by a glacier which melted on a slope of the famous Yosemite Valley, California, a vast gash in the Sierra Nevada, now believed to have been largely cut out by glacial action. Since the boulder was so deposited it has changed but little. The sandstone pedestal, however, is greatly weathered and in the natural course of events, in a few hundred or a thousand years perhaps, will further disintegrate. Then the boulder will be precipitated down the steep slope of the gorge into the canyon below.

A Typical Crevasse Caused by the Earthquake Which Demolished San Francisco

What are now the beautiful Tuolumne Meadows of California were formed by billions of tons of rock and soil, including many great boulders as large as houses, which were transported by glaciers from the Sierra Nevada. Most of this material has been formed into soil and grass, trees and running streams all to make a beautiful natural park. A few great granite boulders still remain to be a witness to the might of a glacier which melted away long ago.

One of the pictures shows a large boulder which is beginning to disintegrate, while the smaller boulder—weighing perhaps a ton—is perched on top of it, having rested in this position for probably the better part of a thousand centuries. Another of the photographs shows a large erratic boulder resting on a rock outcrop in Mono Valley, California. Undoubtedly it was transported to this point from the nearby Sierra at a time when the ice streams flowed strongly down the eastern slope of this range to levels much lower than those reached by the feeble glacier remnants now existing near the summits of the range. This boulder could have been brought to its present position only by some agency not now present and one that would disregard topography, riding over irregularities in land surface and leaving erratic rock fragments perched in positions to which water could not transport them.

The famous Balanced, or Rocking, Stone of the Garden of the Gods in Colorado was deposited in a similar way by the glaciers of the Rocky Mountains. It is a stone of very large dimensions, and so exactly does it balance that until lately it could be swayed easily. The continual rocking to which it was subjected by thousands of tourists ground away the base to such an extent that to preserve it as a curiosity it was cemented in place.

One of the Pranks of the San Francisco Earthquake

ABOVE is one of the crevasses caused by the earthquake which almost destroyed San Francisco. Earthquakes are always terrifying events, but they are only excessively destructive of life and property in case the territory affected is thickly populated and highly improved. At this uninhabited point the great earthquake of 1906 resulted only in a natural curiosity, but imagine this rift occurring beneath the business block of a prosperous town! In another place a quarter of a mile of wagon road was bodily removed ten or twelve feet from the rest of the road.

Even the Hornets Have New Ideas Sometimes

EIGHT hundred miles up the Amazon River, in South America, a hornet's nest was found recently which is unique in the annals of wasp architecture. It is constructed of clay, put together not in tiers after the custom of wasps, but in a solid mass, the weight of which may be judged from the accompanying photograph in which the nest is shown suspended on a stick and requiring both hands of the exhibitor.

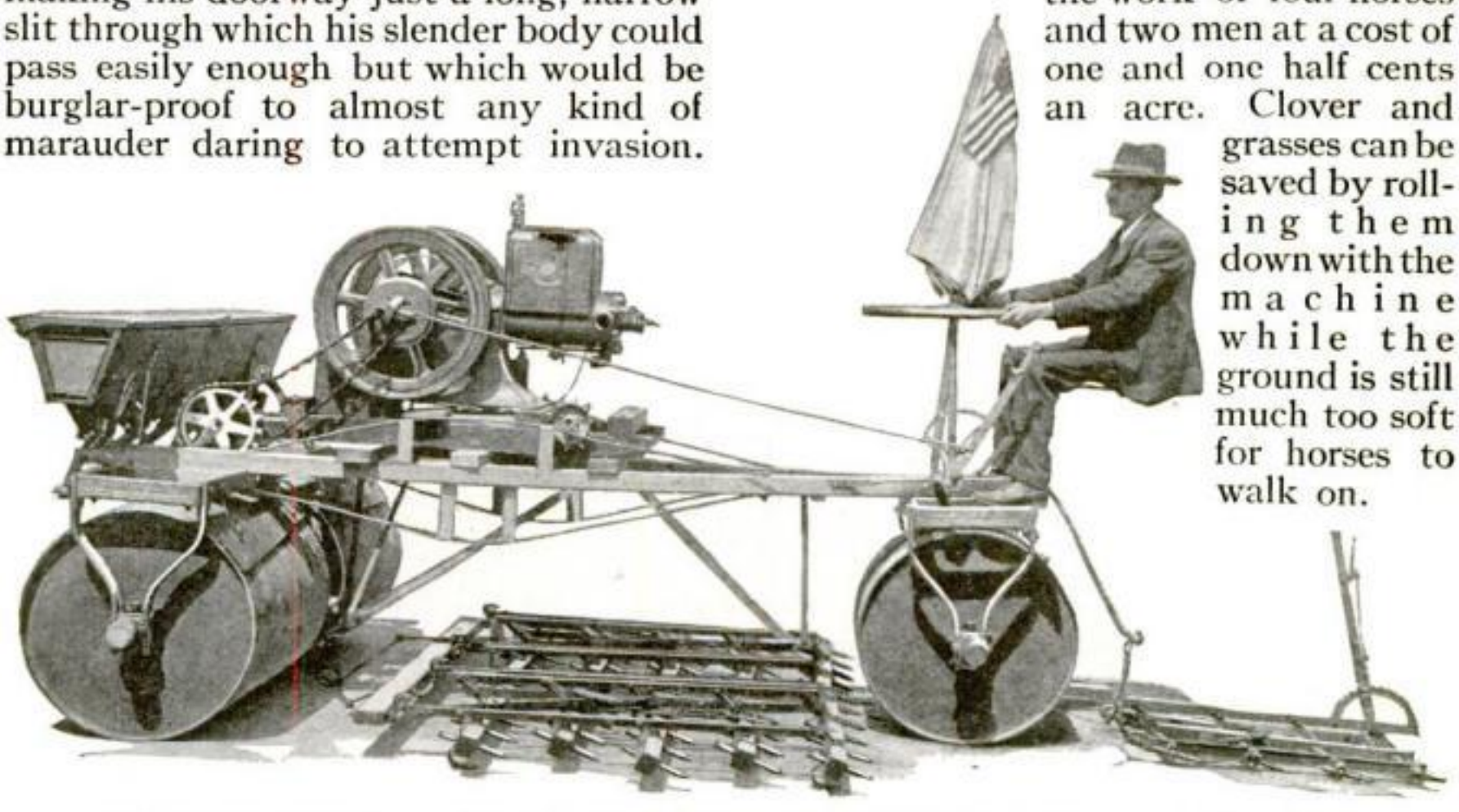
The Sun Has Baked This Wasp's Nest Until It Is as Hard and Almost as Heavy as if It Were Made of Stone

The rounded wall is unusually thick and a question arises as to how the tiny builder came to the conclusion that the best way to keep his house cool in that torrid temperature was to put as much solid cement between its interior and the sun as he could get. He evidently figured, also, that his body would require less space if he slid into his home lengthwise than if he flew straight in, in the usual way. He tried it out, anyway, making his doorway just a long, narrow slit through which his slender body could pass easily enough but which would be burglar-proof to almost any kind of marauder daring to attempt invasion.

Rolling, Harrowing and Seeding With One Machine

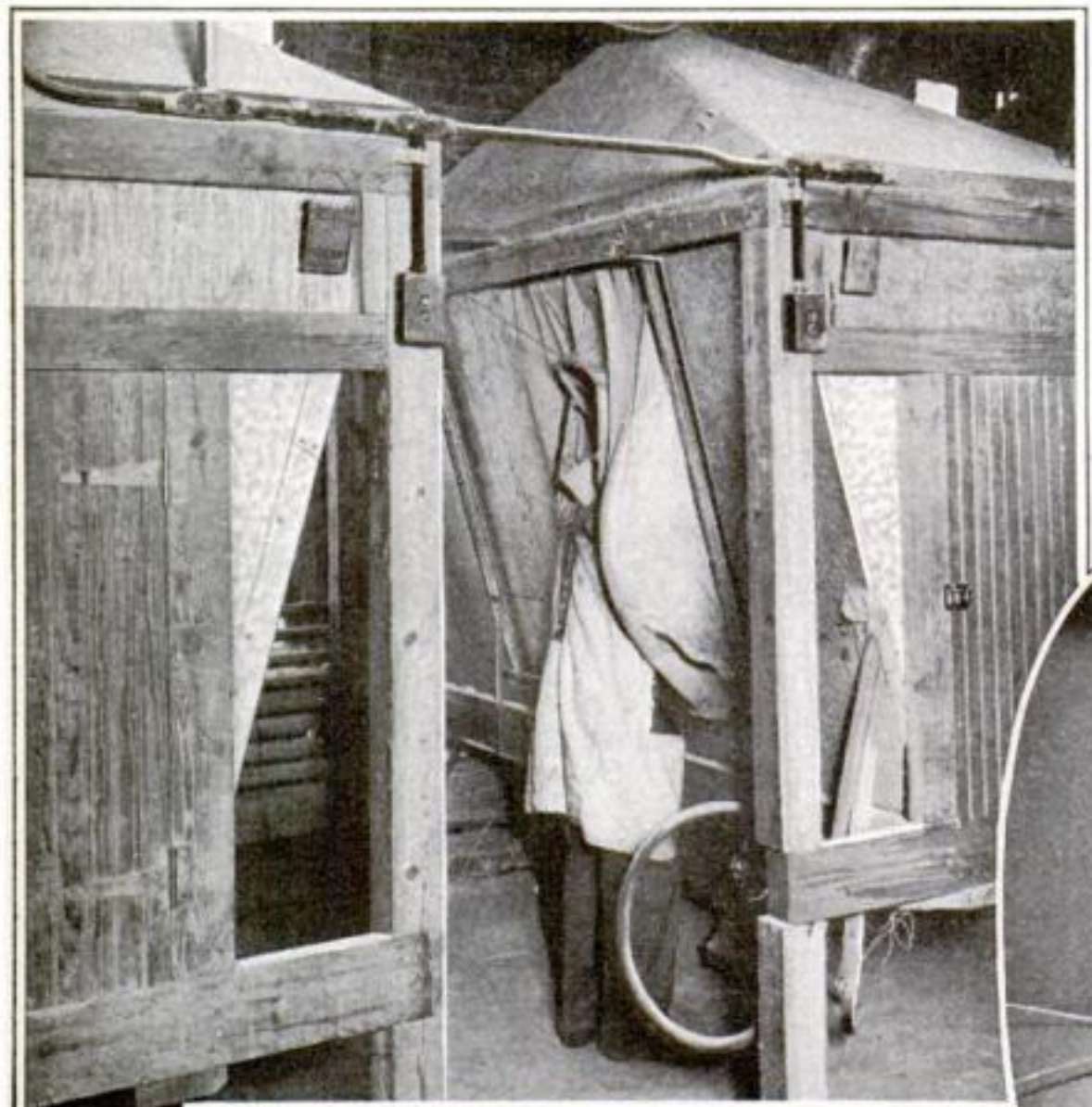
AN internal combustion engine takes the place of horses in driving the combined roller and harrow invented by an Indiana man. With the machine a field of growing grain can be rolled without uprooting it by the travel of horses' feet. One or more harrows can be combined with the rolling implement, or may be omitted from it, according to the work to be done. A seeding attachment is provided at the forward end of the machine. Clover seed, for example, may be sowed broadcast by the seeding attachment, the seed rolled into the soil, and then harrowed to prevent the surface from becoming encrusted. Or the operation of the machine may be varied for other seeds, soils, and conditions.

The direction of the travel of the implement may be reversed and the soil harrowed, rolled and the seed sown upon the rolled surface. The machine does the work of four horses and two men at a cost of one and one half cents an acre. Clover and grasses can be saved by rolling them down with the machine while the ground is still much too soft for horses to walk on.



The Combined Roller and Harrow Which Does the Work of Four Horses and Two Men at a Cost of One and One Half Cents an Acre, to Say Nothing of the Time Saved

Safeguarding the Sand Blaster



At Left, the Hopper Where the Workman Operates. A Strong Suction Saves the Sand and Draws Off the "Flour" So Dangerous to the Lungs

The Head-Dress Allows a Free Passage of Air About the Head and Through the Fine Copper Gauze Which Protects the Eyes. The Hands Are Heavily Gloved

THE preparation of metal surfaces for a covering of paint has given rise to the extensive use of sand blasting outfits. When these are constructed of sufficient capacity to accommodate large surfaces such as are presented by automobile guards, hoods and bodies, the problem of protecting the workmen presents some difficulties.

Fine quartz sand is sprayed against the metal surfaces, causing a certain amount of disintegration of the particles of sand into a powder as fine and volatile as flour. This sand flour is very penetrating, and many ingenious devices in the form of head-dresses are now in use to protect the face and lungs of the operator. The familiar helmet with its sponge through which the operator breathes is adapted for this purpose. On account of the cutting properties of the sand, glass cannot be used, and the substitute is an exceedingly fine copper gauze giving the necessary range of vision.

Such devices are only partially successful from the standpoint of protection, and can only be relied upon when built in the form of a diver's head-dress and supplied with fresh air under pressure. Operations were first conducted to cover the larger detachable sheet metal automobile parts such as dust shields, fenders, hoods, etc., and after many experiments, the device, as illustrated, has successfully solved the problem.

The container is of the familiar hopper type, with a strong suction both over the top and underneath, carrying only the heavy particles of sand flour to the bottom of the hopper, where they are collected and again drawn through the air-suction hose. In this way the sand is used over and over again, and only the flour is drawn off. Fresh sand is introduced through the large door at intervals, each unit caring for its own sand supply. The work is introduced by

a helper through the large door, and the operator has his head and arms strapped into a head-dress constructed so that the curtain forms the front of the hopper. This curtain is attached to sliding metal doors moving horizontally, allowing the workmen to move from side to side at will by the pressure of their elbows upon the metal leaves.

The head-dress is constructed to allow a free passage of air about the head and through the fine copper gauze into the sand blasting department. The strong suction in the sand blasting department sets up a sufficient vacuum to cause the fresh air to circulate around the head of the workman and the copper gauze into the sand blasting department. This affords a constant supply of fresh air for the operator, while the inrush of air clears the copper gauze and assists the vision of the operator. In practice the amount of fresh air drawn through this head-dress is so great that the workman wears a shield on the back of the head as a protection from the draft.

Sand Blasting Automobile Parts with the Modern Head-Dress. The Fresh Air Is Supplied Under Pressure

In operation a considerable economy is effected through the use of a much smaller system of exhaust and dust collecting. Less sand is required and the total saving of power and material is increased. A battery of twelve of these outfits is at work in an open room, and no discomfort is experienced by either the operator or others working in the vicinity. The same principle is applied to sand blasting automobile bodies.

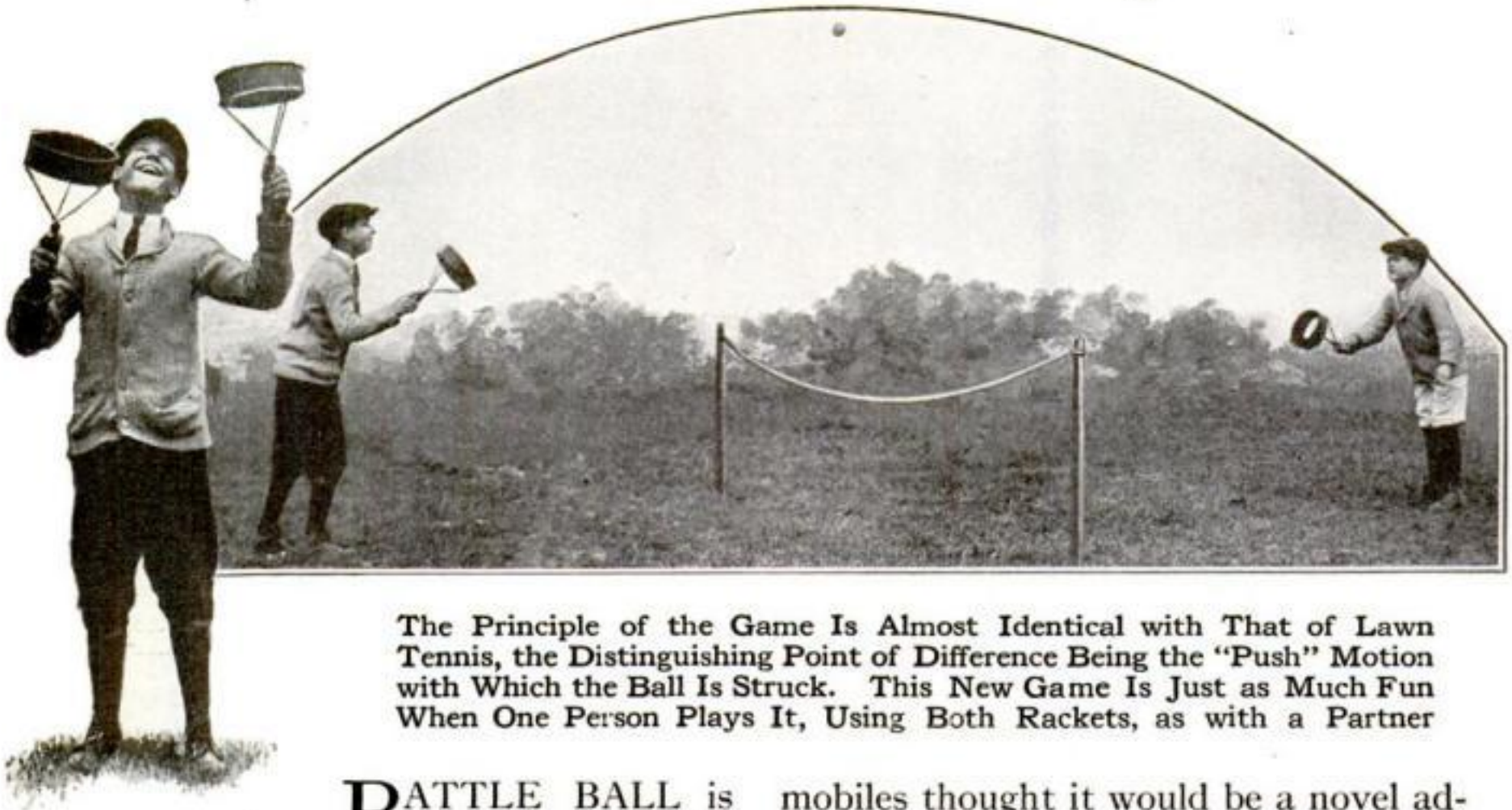
Why Not Make Rain Work? A Chance for a Rain Motor

THERE have been numerous attempts at utilizing the energy of the sun and the tides, but it is doubtful whether the energy of rain has ever been considered. A little figuring, however, will convince one of the enormous force yet unharnessed.

One inch of rainfall is not uncommon in this country, yet every time this happens the earth is moistened with a paltry 113 tons of water to the acre, or 72,480 tons per square mile. The annual average rainfall the world over is estimated at 36 inches. Using this value and our first figure, we arrive at the astonishing result that the average rain falling on one square mile in a year is 2,609,280 tons in weight. How small is this figure, though, when we think of parts of British India where the precipitation is given at 610 inches.

A law of physics says that work equals force multiplied by the distance through which it acts. Let us consider the energy of all this weight of water falling from the clouds. The height of clouds is estimated at from two to three miles, but to allow for seasonal variation and the lower height of rain clouds let us take 2,000 feet. Using this figure we find that the average work done by falling rain in 24 hours is 22,320 foot-tons per acre—assuming our annual average rainfall of thirty-six inches distributed uniformly throughout the year.

Battle Ball—A New Sport



The Principle of the Game Is Almost Identical with That of Lawn Tennis, the Distinguishing Point of Difference Being the "Push" Motion with Which the Ball Is Struck. This New Game Is Just as Much Fun When One Person Plays It, Using Both Rackets, as with a Partner

BATTLE BALL is the name given to a sort of first cousin to the popular game of tennis. It is a new outdoor game devised by a resident of Virginia. It is played with a racket of novel construction and cloth-covered rubber balls used in tennis. The racket is circular in form with a wide band across which the woven gut of the racket is stretched. The handle is positioned in alinement with the center of the band, to which it is attached by three wires. The rackets are less expensive than those used in tennis.

The game may be played by two or four players, or it may be played individually, offering an excellent means for exercise. If the player is adept the ball is thrown in the air from one racket and then caught by another racket as it falls, and bounced back and forth indefinitely. The game requires a degree of skill sufficient to make it fascinating.

An Example of Motor-Cycle Dare-Deviltry

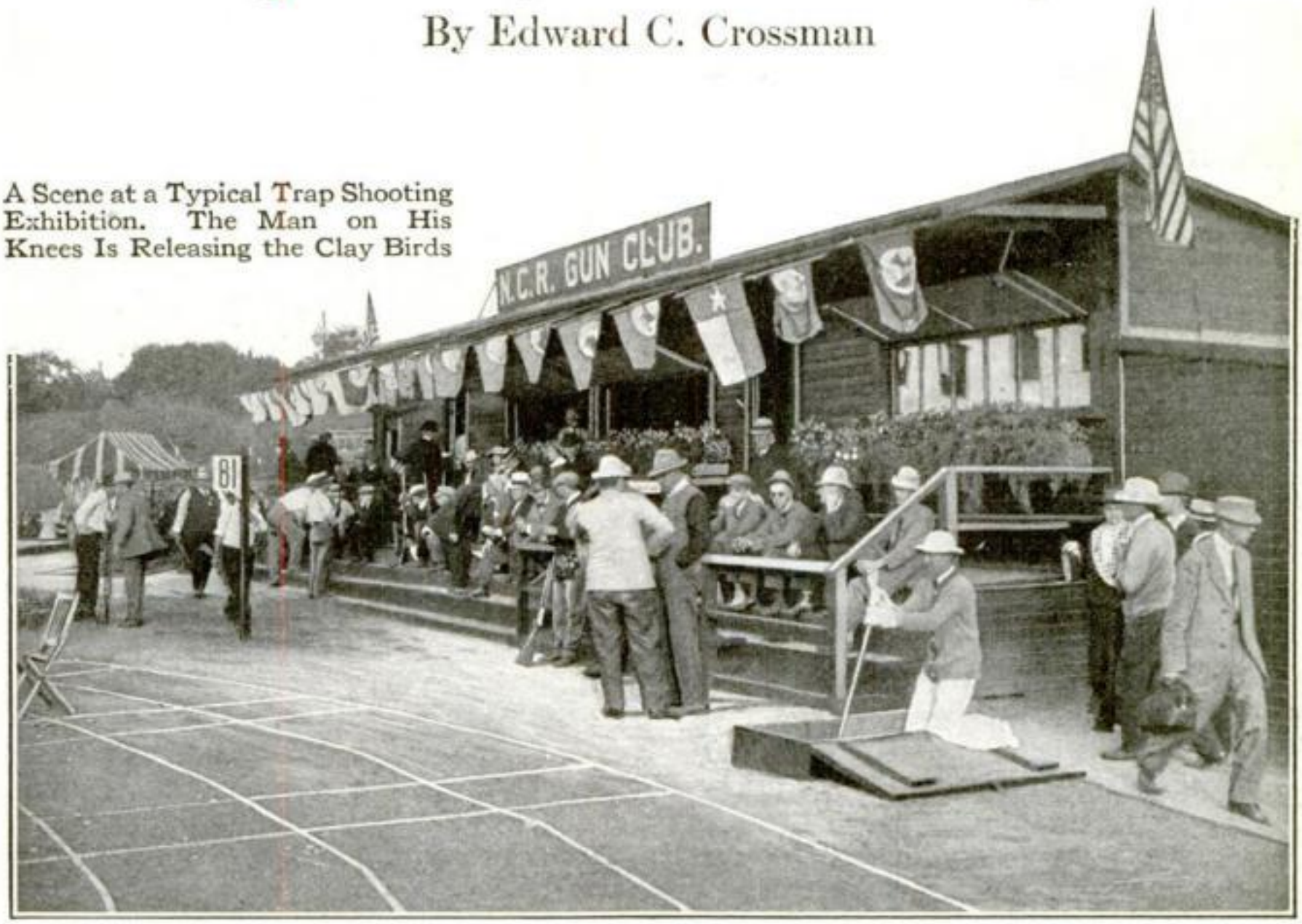
AMERICAN motor-cyclists are constantly keeping their English cousins amazed by the perilous feats they accomplish with their American-made motor-cycles. When the Boquet Siphon of the Los Angeles Aqueduct was finished recently a manufacturer of automobiles thought it would be a novel advertising trick to run his car on the siphon. It was a comparatively easy job to get the car on the pipe and when once there it was impossible for it to fall off. The driver could have fallen asleep with safety. Of course the photographs were disappointing.

But when a motor-cyclist came along and contemplated doing the trick people from surrounding cities gathered to see the event. Unlike the automobile, the motor-cycle had to pick its own way and that had to be done with the aid of handlebars in the hands of the driver. Harry Hartz was the driver. He mounted the pipe without fear and on his first trip kept his eyes on the track ahead. On the second trip, however, he looked behind him and actually closed his eyes.

Riding a Motor-Cycle on the Big Los Angeles Siphon. After Several Practice Trips the Rider Actually Performed the Dangerous Trick with His Eyes Closed

Getting Ready for the Clay Birds

By Edward C. Crossman

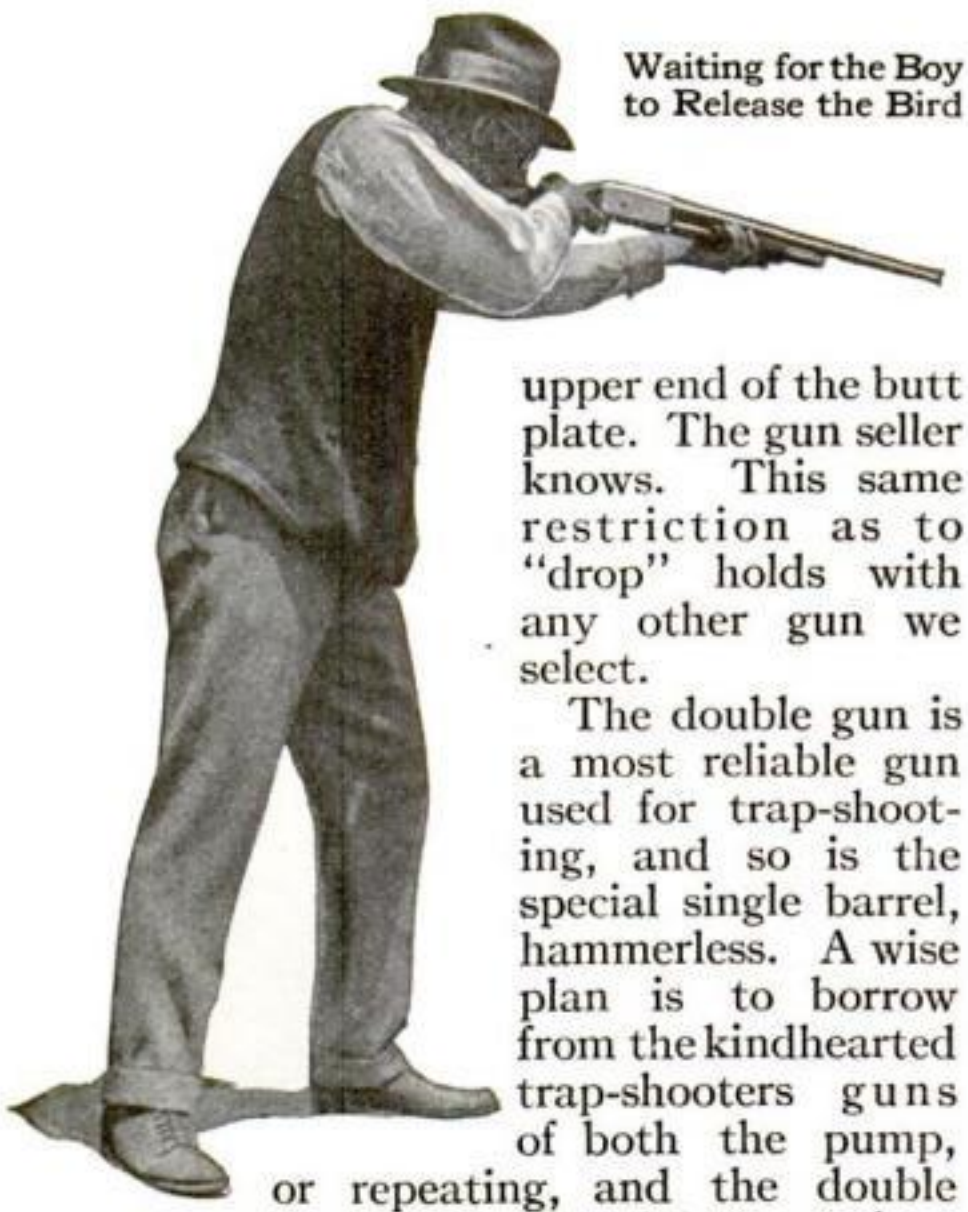


A Scene at a Typical Trap Shooting Exhibition. The Man on His Knees Is Releasing the Clay Birds

ONCE too often we trekked to the place of the flying saucers. The spell of the clay bird is upon us. And so, perforce, we toddle down-town to the mart of the gun sellers and there consider the guns that are suitable for breaking the clay.

By the rules of the game our task is a bit simplified. We may not under the rules use more than one and one-quarter ounce of shot. We may not use a gun larger than twelve-inch bore. By the rules of common sense, desiring to compete on equal basis with other clay bird devotees, we cannot go below this allowance. We need no such handicap, for a time at least.

Seeking a gun no lighter than seven and one-half pounds for the sake of our shoulder, we find spread out before us divers weapons, all of them represented at the grounds of the clay bird. The cheapest is a single barrel, single shot weapon, hammerless, cheap in finish, good enough to break clay birds, costing about fifteen dollars, but a little underweight. Unless our contemplation is to use such a gun merely until we find ourself, it is not the gun to choose, because it is not quite adequate for the skilled shot. Next in price and most formidable in efficiency is the repeating shotgun of various makes. Thousands of them are in the hands of the most skilled trapshots in the country. The weapon is not quite so simple for the beginner to handle as the double-barrel gun, and the reach to the slide-handle, by which the gun is operated, is a bit long for the short-armed man. The cost in plain quality runs less than twenty-five dollars. In guns with checked fore-stock or slide handle and checked grip, the cost is about thirty-five dollars. No better weapon is made for breaking the birds, but some people find that they shoot better with the double barrel. Does our choice fall on the repeating shotgun, then it must have barrel no shorter than thirty inches, stock with "drop" or crook from the line of the barrel no more than one and one-half inches at the comb and two to two and one-quarter inches at the heel, which is the



Waiting for the Boy to Release the Bird

upper end of the butt plate. The gun seller knows. This same restriction as to "drop" holds with any other gun we select.

The double gun is a most reliable gun used for trap-shooting, and so is the special single barrel, hammerless. A wise plan is to borrow from the kindhearted trap-shooters guns of both the pump, or repeating, and the double type, and with them to sight at various objects to give us an idea as to which of the two types seems to suit us, individually, better.

Selecting a Gun

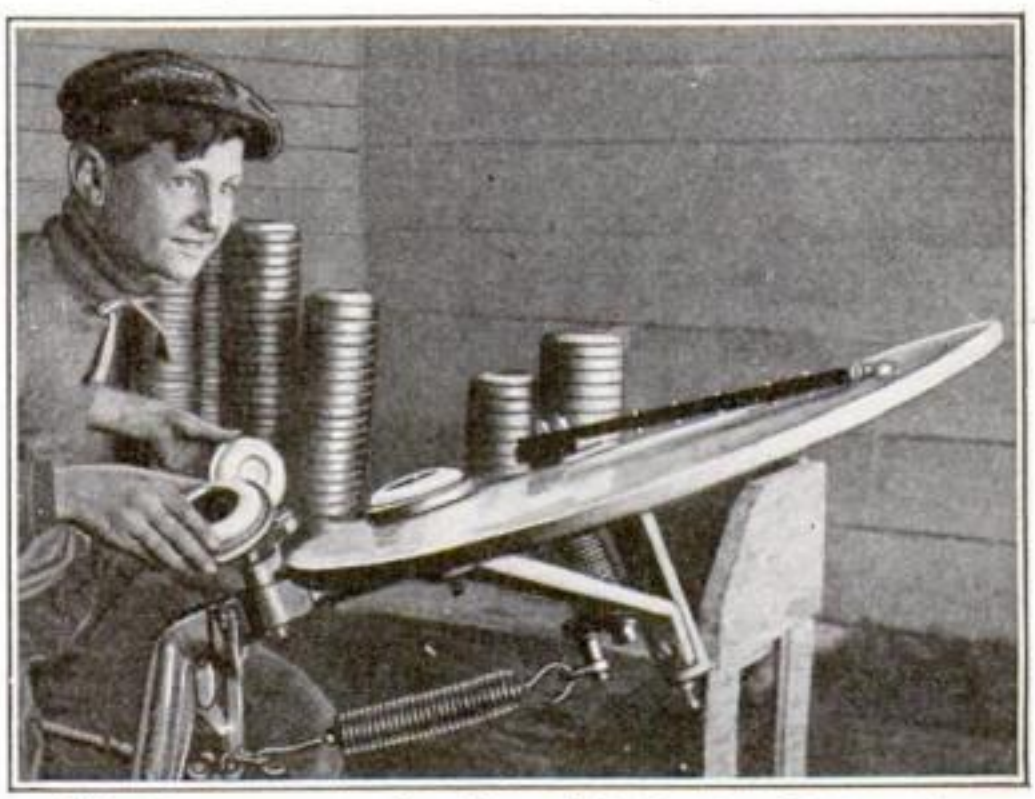
If our choice is the double, then it should have, if possible, thirty-two-inch barrel and be of the stock dimensions laid out, and the stock for a person of normal build should not fall below fourteen and one-half to the front trigger, measuring from the edge of the butt-plate in the center of the stock. The gun also should have automatic ejectors—little hammers in the fore-end, which, when the gun is opened, kick the fired shell out of the gun without the aid of the fingers.

We want the butt-plate fitted with some one of the rubber pads made to take up recoil. The most commonly used is the sort that is glued firmly on as part of the stock. But before we do this we must make sure that the gun shoots as a trap-shooting gun should, and second, see that the gun fits us. The best plan is to instal on the gun temporarily one of the cheap lace-up or slip-on rubber recoil-pads, costing about one dollar. This will make the stock longer, and usually we can use it longer than it is put out; because in trap-shooting, being allowed to have the gun to our shoulder, we can use a stock longer than we could in the game field, and the extra fraction of an inch adds to the steadiness of swing. If, however, there is too much of a good thing, shown by the greater control over the gun in shooting a few shots with the pad taken off, then we can decide that a shorter stock is correct, and so have the permanent rubber pad glued on, at the cost of about five dollars.

With the appointed gun and three sorts of trap loads, obtained from the obliging dealer, we obtain a dozen sheets of wrapping paper, not less than forty inches square, some thumb tacks, a tape of twenty-five feet or longer and seek in the country an old board fence or an old abandoned barn or board sign on which we can tack our paper. The trap loads should contain not more than three drams of smokeless powder, and one and one-quarter ounce of No. 7½ or 8 chilled shot. Three different makes of shell or three different brands of powder should be represented in the loads we take out.

Testing Your Gun and Your Powder

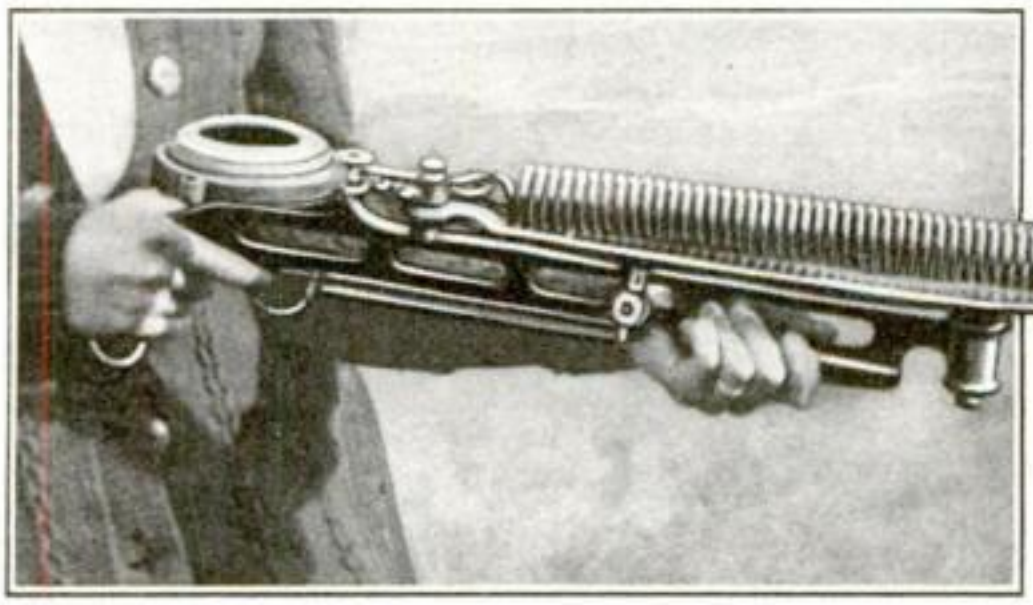
First we cut open and count the pellets in one of the shells. The easiest way is to pour them into a box, shake them into



The Operator at the Trap Mechanism Below the Ground. Several Piles of Clay Birds Are Shown

even, parallel rows, count one row and multiply by the number of rows. As a rule 7½ will run 430 to the trap load, 8 will run 500 to 525. The 7½ is the best size, taking windy days and all into consideration.

Then we tape off just forty yards from the board, aim carefully at the center of the paper and fire a load at it. See that the gun apparently shoots straight—puts the center of the load where you aimed, or a bit higher.



A Clay Bird Trap Operated by Pulling the Trigger. This Is the Most Common Form of Automatic Trap

With a fifteen-inch piece of string carrying a pencil at the end, we describe a thirty-inch circle around what is apparently the center of the "pattern," shown by the shot marks in the paper. Checking off each hole with a mark of the pencil, we count the marks in the magic circle.

The gun you want must put from seventy to seventy-five per cent of its charge into the circle. Set down your count, and divide it by the number of shot in the whole load. Seventy per cent of 430 is practically 300; seventy-five per cent is practically 320. Shoot several sorts of loads, and several shots with each load, counting and setting down the results of each.

If with any one load the gun shoots better than seventy per cent and shoots evenly, leaving no apparent "holes" or empty spaces much larger than the four and one-quarter-inch clay bird, it is all right. Submit the patterns to the gun seller. He can advise you of their suitability for the clay birds. In this as in most games, the advice and guidance of the experienced shot is worth more than any printed page.

To back up, the gun shooter needs a shooting jersey, either without shell pockets and with a shell bag, or with special reinforced pockets to hold a box of shells between the two. Large shooting glasses of green or amber tint aid the vision and keep out stray bits of dirt or powder. A glove for the left hand, loose and easy to slip on, is advisable. A cap beats any heavy felt hat. No "biled" shirt, no stiff collar, can be tolerated in the outfit of the trap shooter. The neck must be free and easy. A soft flannel shirt with tie, a neat Norfolk type of suit of neutral color, a cap, and a jersey make the best shooting clothes.

By Pulling a Lever the Clay Birds Are Shot Into the Air Forty Yards Away

Learning How to Shoot

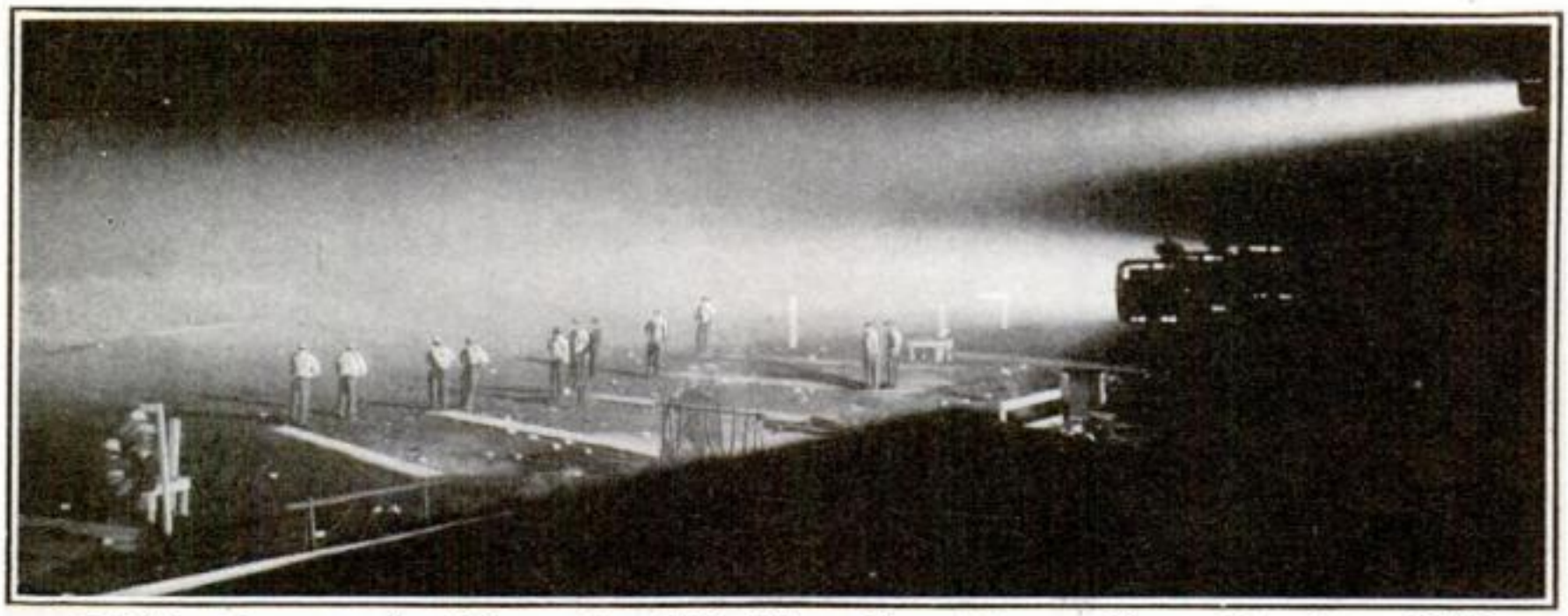
Nothing is more tiresome than the tyro in any game who expects to learn first principles by actually engaging in the game itself. The technique of a game, such as shooting or golf, can be acquired in other places than on the shooting grounds or the links and will prove less obstructive to those more advanced. Let the tyro practice at home with the *empty* gun containing an *empty* or fired shell to absorb the blow of the hammer, bringing the gun to the shoulder, bedding it firmly, cuddling the face down on the stock until the right eye looks along the rib at a height of two silver dollars laid flat on the barrel. At no time must the breech or the barrel obscure the

vision; the eye must be above the line of the rib or barrel. At no time must the left eye be closed.

There is at times, the fatal presence of a "master left eye." One eye or the other does the guiding, the other or non-aiming eye merely aiding in the estimate of the distance and angle of the bird. If the left eye is the master eye then the remedies are four. One is to learn to shoot from the left shoulder: the second, shot, fought this trouble for years with the shotgun and finally had to take to closing one eye with this weapon.

Some of the finest shots with firearms, rifle, pistol and shotgun, practice assiduously at home with the empty weapon. Why should the tyro feel that he can learn all there is to learn by actually firing?

Let him practice pointing the empty gun a little below horizontal as he would



A Night Scene at the Chicago Gun Club Where Some Famous Shoots Have Been Held

to make the right eye the master by persistent practice at the right shoulder with both eyes open; the third, to have the stock made to fire the gun from the right shoulder but crooked so as to bring the barrels before the left eye, and the fourth, to close the left eye at the instant of aiming, which is done by some trap-shots but should not be done unless it is imperative through the left master eye.

The quick and infallible test is to hold up a finger-ring at arm's length and to gaze through it with both eyes open at some distant object. Without moving it, close the left eye and see if the right is still gazing through it. Reverse this, still without moving the ring. Repeat several times. The master eye will be found looking through the ring every time, and the other eye will see the ring off to one side apparently several inches.

If the gun is shot with both eyes open from the right shoulder, with the left eye the master, the left eye will infallibly drag the muzzle over between itself and the bird, putting the gun entirely out of alinement and making the shooter miss the bird to the left. The lady of the writer's family, a fine rifle and pistol at the edge of the forward side of the trap-house, say "pull" to himself, and then swing rapidly up after the imaginary bird, pressing the trigger when the gun reaches what he feels is the right spot. A black spot on a white wall, a generous spot like a one-inch black paster at a distance of a dozen feet, is right. If he is standing at the imaginary No. 3 peg, which is just back of the center of the trap, then the birds can come out at any angle within forty-five degrees of the straight line before him to the imaginary trap.

How to Handle the Gun

First he must learn the fixed, glued relation of face, hands and gun stock. All movements in trap-shooting are done from the hips. Read this again, and study it. The position of face-on stock is the rear sight of the gun. Regardless of any field experience or of any beliefs, the tyro must glue himself into an immovable relation with the gun after it comes from the shoulder. If he swings after a bird, the swing must be from the hips; the face, hands and stock must not change relation until the shot goes. If

he raises after a bird coming up out of the trap and going straight away, he must not perpetrate the invariable trick of the beginner—raise his head from the stock; but he must make the move one of the whole body, the face, stock and arms not changing relation.

Time is the most important part of trap-shooting. The tyro must learn to fire in the same time, and that quickly. This means that the shot must go before the bird has started on its downward curve, and the sooner the gun can be brought on the bird, the better. The instant the bird goes the gun must swiftly and smoothly swing after it—not jerk after it—catch it, and then the trigger must be pressed without stopping the motion of the gun. Straightaway birds are hit as a rule by pressing the trigger just as the muzzle comes to the lower line of the bird but without stopping the upward swing. Quarterers are hit by a swift swing by them and a release of the trigger when the gun is from a foot to three feet ahead, depending on the speed of the swing, which in turn depends on the individual.

The birds leave the trap with the initial speed of one hundred and fifty feet a second and cover the shooting distance with the average speed of one hundred feet a second. Shot takes the seventh part of a second to travel forty yards, which is about the distance at which you would fire at a bird. The seventh part of one hundred is practically fourteen and one-half feet, and so, while our shot is travelling forty yards, the bird is getting nearly fifteen feet. If it is a quartering bird to you, angling across your line of fire, a little paper and figuring will show you plainly enough why you cannot shoot *at* a bird of the sort and hit it. All motions must be smooth and speedy, not the convulsive jerks of the typical tyro, nor yet the slow poky aim of other tyros. Practice at home, first.

From any of the big powder or ammunition or gun companies you will be given printed matter on how to organize a gun club, on how the purses in tournaments are split, where to find your nearest club if you do not know where it is, and all the small points of the game.

Another illustrated article on trap-shooting by Mr. Crossman—"Hunting the Mud Pigeon," it is called—will appear in the October issue.—EDITOR.

A Modern War Relic

THERE are few towns in the eastern half of the United States that cannot boast of at least one antiquated cannon ball, a relic of the Revolutionary War or of the Civil War; but Quantico, Va., is perhaps the only community that can boast of a modern fourteen-inch steel projectile that fell in its midst.

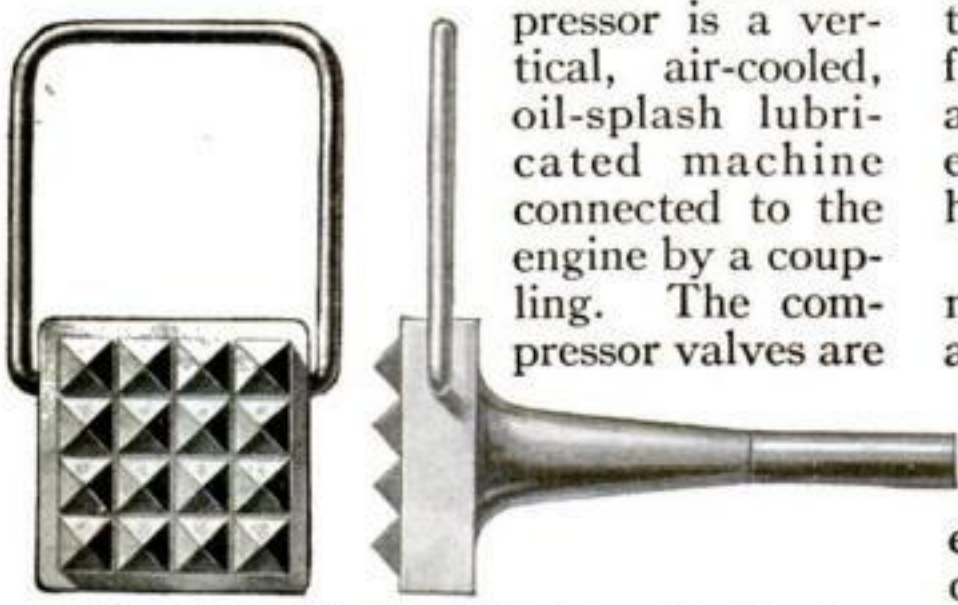
Quantico is about ten miles below and on the opposite side of the Potomac River from Indian Head, Md., where the United States Navy tests the big guns for battleships. To determine their penetrating qualities, shells are fired at armor plate set up before a sand bank several hundred feet from the guns, but when tests are made to study the performance of the firing and recoil mechanism the guns are elevated so as to drop their shells in the middle of the Potomac River, several miles below. Fast motor boats patrol the river to keep vessels out of range.

This Steel Projectile Weighs 1,250 Pounds. It Killed a Cow and Damaged Houses

Quite often the shells hit the water at an angle which causes them to "skip." A short time ago the "skipper" shown landed in Quantico.

Smoothing Sidewalks by Machine

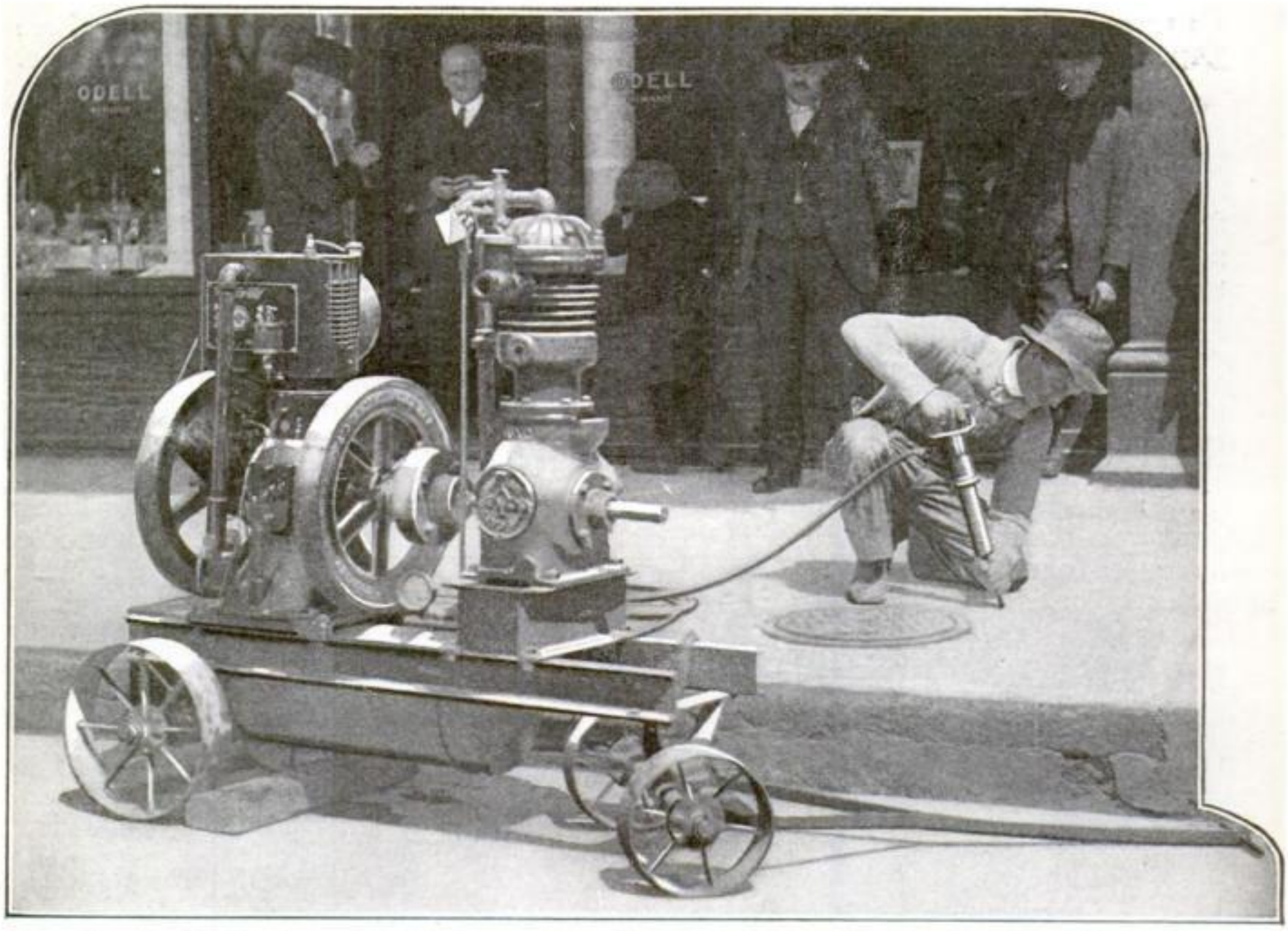
AN outfit for roughing stone sidewalks has been perfected and placed on the market by an Illinois company. It consists of an air-cooled air-compressor driven by a gasoline engine mounted on a light steel truck. The compressor is a vertical, air-cooled, oil-splash lubricated machine connected to the engine by a coupling. The compressor valves are of thin flexible sheet-steel and cannot be drawn into the cylinder.



The Tool Is Fitted with a Case-Hardened Steel Block with Sharpened Raised Points

The tool is an ordinary plug drill fitted with a case-hardened steel block with sharpened raised points which do the work. In chipping around cracks and posts set into the sidewalk a trimming tool is used. An unloading device furnished with the compressor keeps the air at the correct pressure for the most efficient work. The block has a wire handle which helps to guide the tool.

The entire outfit is operated by one man and the work is done expeditiously and thoroughly. The truck is made somewhat on the order of a boy's express wagon except for the fact that it is of steel. The machine is equally adapted to use on stone or cement walls or interiors wherever roughing is required, the pressure being uniform whatever the position or angle.



The Outfit Consists of an Air-Compressor Driven by a Gasoline Engine. In Chipping Around Cracks and Posts or Openings Set in the Sidewalk a Trimming Tool Is Used

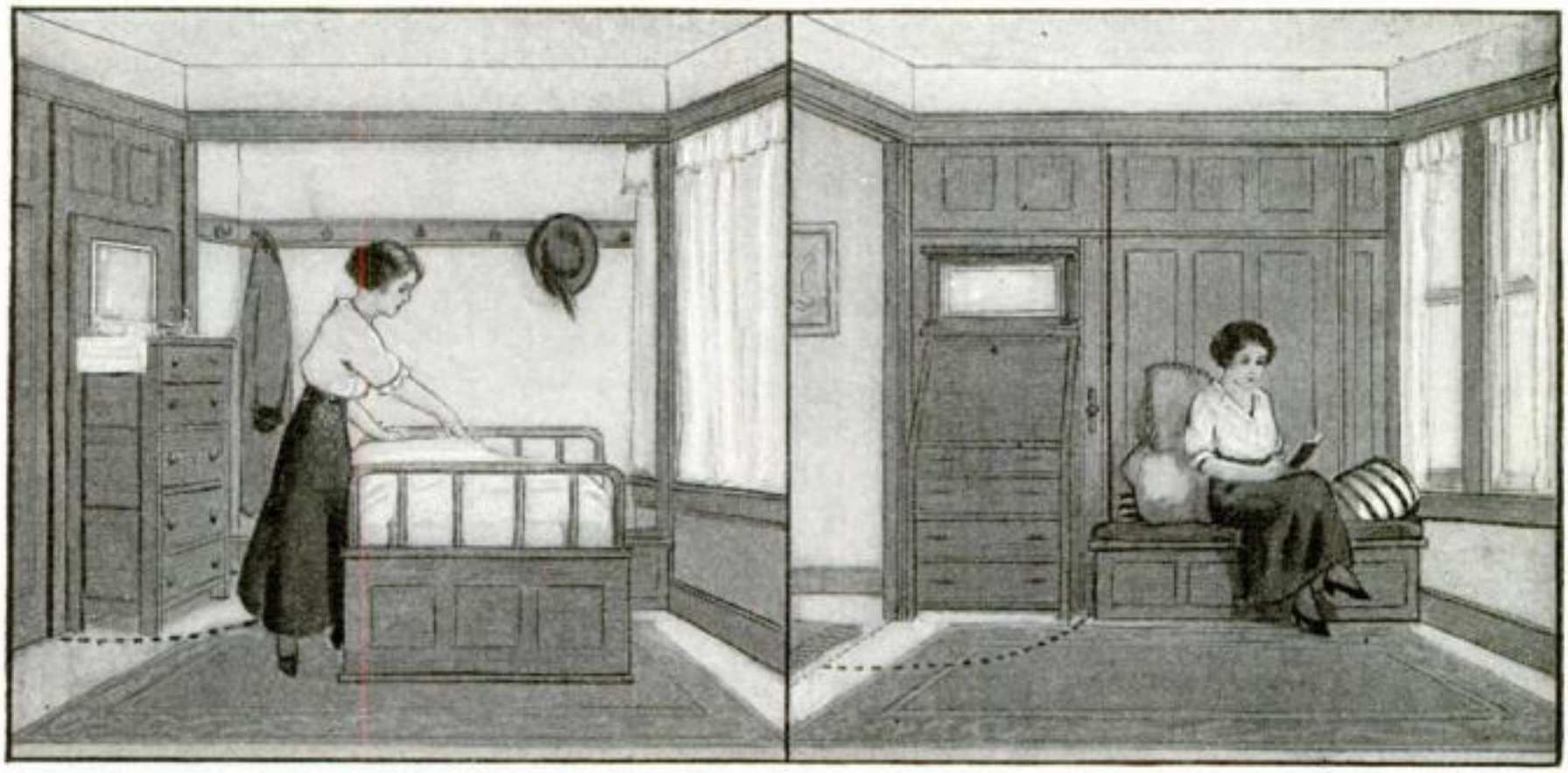
Secret of a Sun-Parlor Bedroom

IN modern apartment buildings a great demand has sprung up for apartments provided with sun-parlors readily convertible, by folding-beds and other convertible furniture, into sleeping porches without such double use being obvious to the ordinary visitor. A Chicago inventor has taken out patents on a device he hopes will solve the problem.

The object of the invention is to so combine the walls of any room, used as a sun-parlor, with its own furniture and with an adjacent or supplemental room, that the desired result is achieved. A swinging door or partition provided with furniture for different purposes or of various characters attached to the opposite sides is used to transform the appearance of the room at any time.

In the accompanying illustration a bedroom is shown on the left and a sun-parlor on the right, being interchangeable by the simple means of a folding bed, and a swinging door equipped with a desk on one side and a dresser on the other. Regardless of the load of furniture the door carries, it cannot sag, due to its novel mounting. When the room is to be changed from a bedroom to a sun-parlor, the swinging door with the dresser attached is swung back against the wall, bringing into position the writing desk. The bed is then folded in its upright position and the room is complete. When the room is to be converted from a sun-parlor into a bedroom the door is swung outward, bringing into position the dresser; and the folding bed is lowered.

The room adjoining the sun-parlor or bedroom may or may not be partitioned off when the swinging door is opened.



The Heavy Door Has a Chiffonier on One Side and a Desk on the Other. The Bed Can Be Folded Up to Form a Seat. Thus a Comfortable Bedroom Can Be Transformed into a Cozy Sun-Parlor

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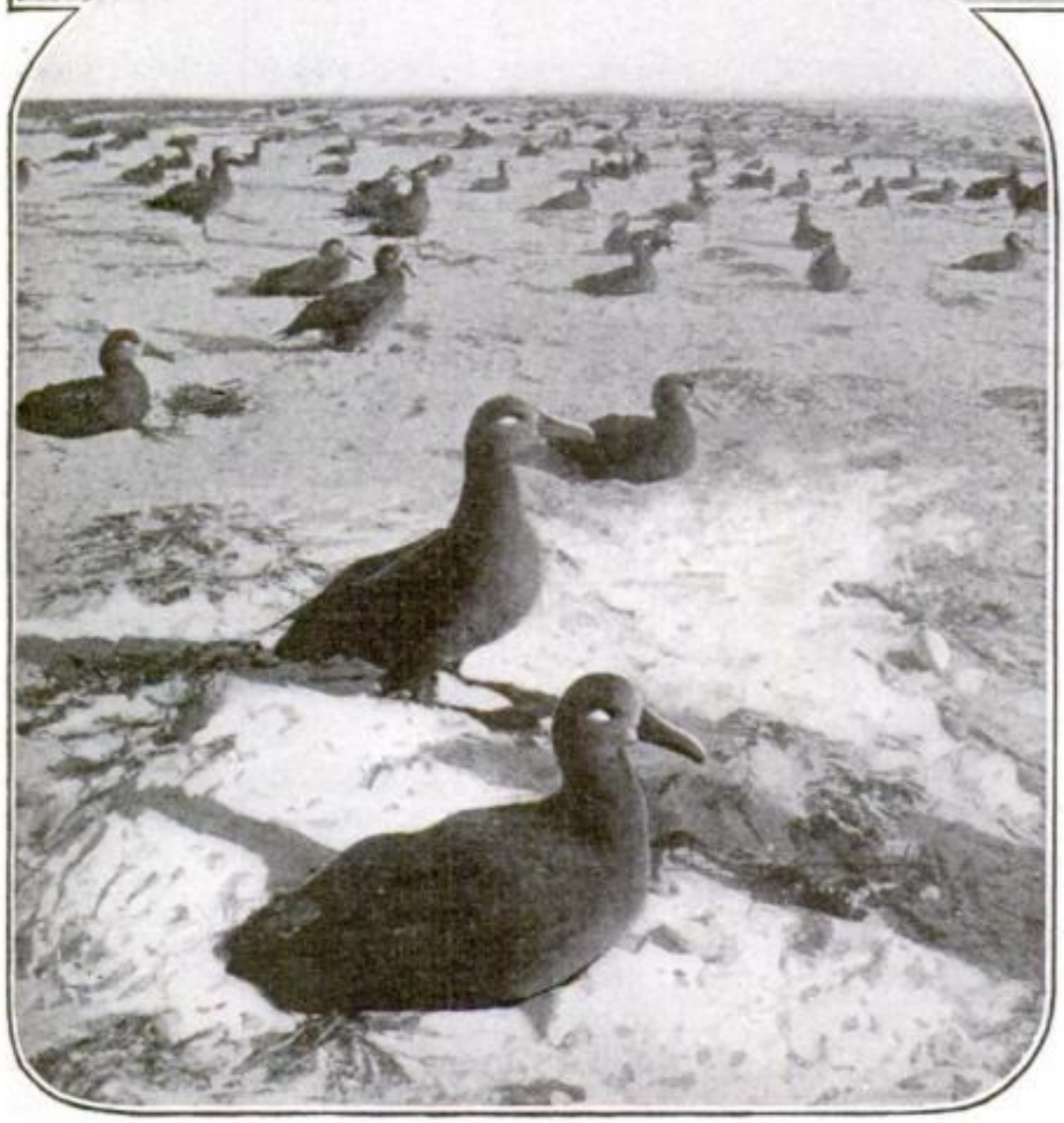
The Preëminence of American Inventive Ingenuity

OF the epoch making inventions of the world during the past fifty years, 48 in number, Americans are credited with 35, which include the telephone, typewriter, cash register, incandescent lamp, talking machine, electric furnace reduction, electrolytic alkali production, transparent photographic film, motion-picture machine, buttonhole sewing machine, carborundum, chain stitch shoe sewing machine, single-type composing machine, continuous process match machine, chrome tanning, disk plow (modern type), welt machine, electric lamp, recording adding machines, celluloid, automatic knot-tying machine, machine for making barbed wire, etc.

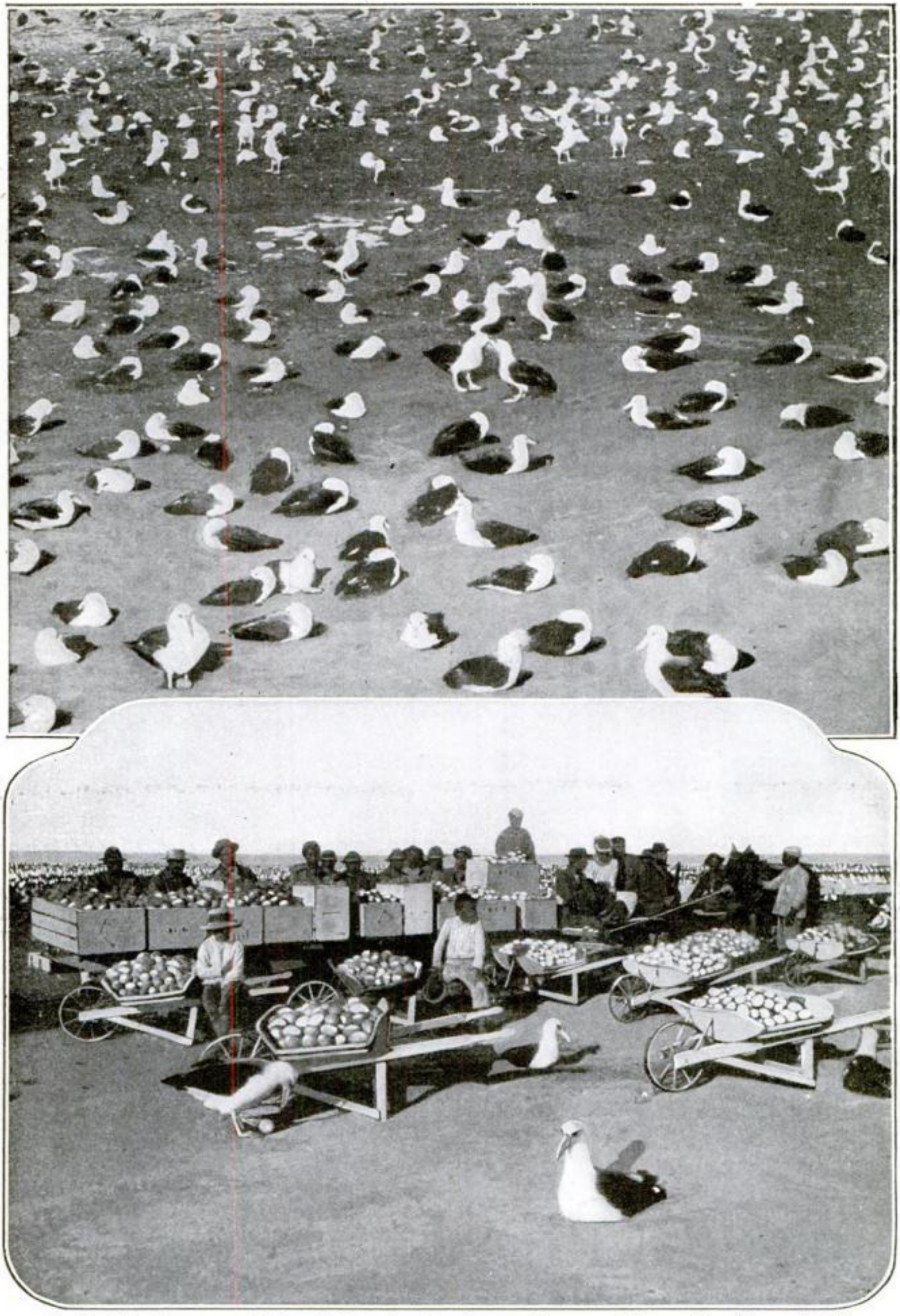
Exploiting the Island of Laysan, in Oceania,



On the Island of Laysan in Oceania, Thousands of Albatross Live from November to January. The Island Is So Rarely Visited That It Is a Veritable Albatross Paradise. The Birds Are Splendid Flyers and Swimmers, but on Dry Land They Are as Clumsy as Geese. The Spread of Wing of Albatross is Seventeen Feet, and the Length of the Body Four Feet

The Albatross Breeds Between November and December. The Nests Are Mere Holes Dug in the Ground and Lined with Twigs and Grass. The Female Lays Only One Egg. In March the Old Birds Leave the Island. They Return in October and Drive Away Their Own Young—Which Have Grown Up into Strong Fighters in the Meantime

for Fertilizer and Eggs, Products of the Albatross

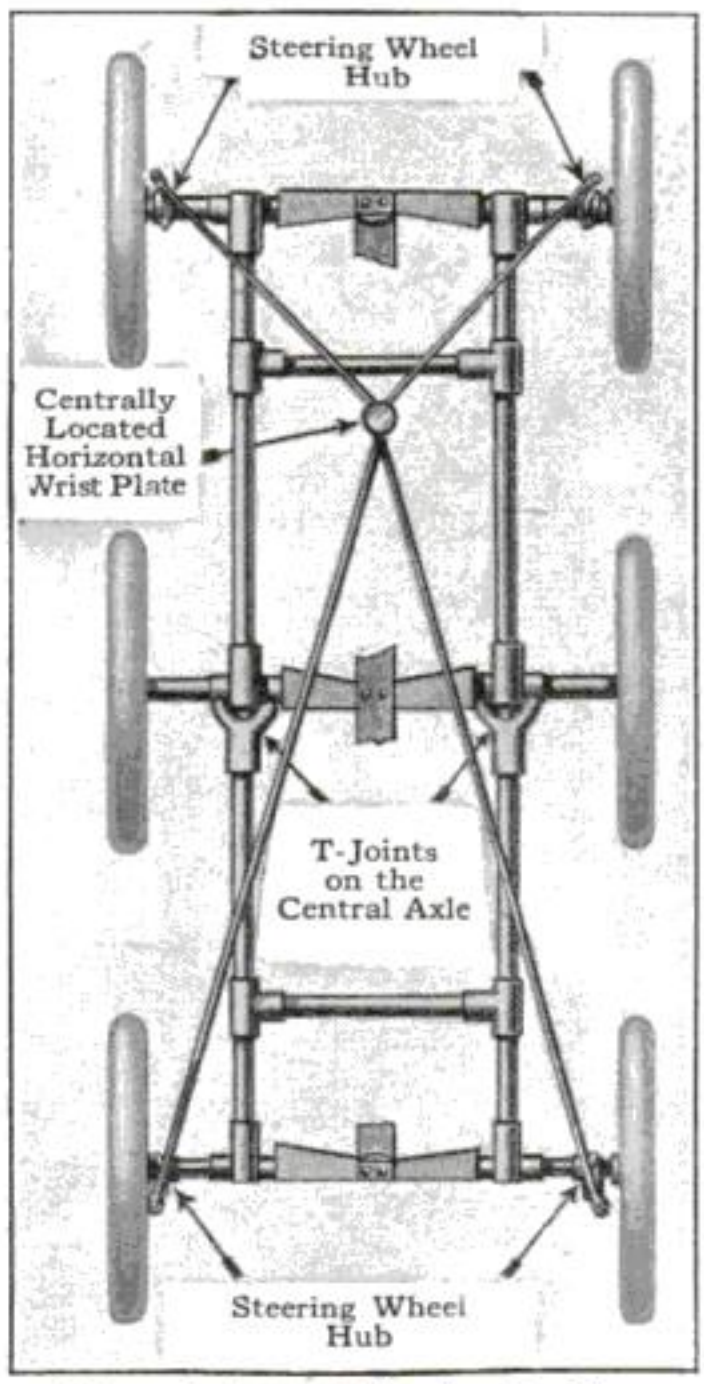


An English Company Is Exploiting the Island as a Source of Guano Fertilizer. A Ship Lands Periodically and the Eggs of the Albatross Are Gathered in Wheel-Barrows. The Eggs Are Sold in Honolulu, Even Though They Are Not as Fresh as They Might Be

A Six-Wheel Automobile

A MICHIGAN inventor has worked out a steering mechanism for four wheels of a six-wheel vehicle. His invention is unique in that it embodies no radical changes from existing methods now in use, but rather distributes the applicable use of those methods. He has found that there are special advantages in driving all four wheels where soft tires are used, as beyond a certain limit the tractive strain on such tires, especially pneumatic tires, is so destructive that it is impracticable to drive with two wheels for a load of more than four or five persons.

Furthermore, he claims that another advantage in a "double" or four-wheel drive where all four wheels are steered, is that the rear wheels always follow the track of the front wheels. In moving forward or backward, turning either to right or left, it is impossible for the rear wheels to get out of the track of those in front. If the front wheels clear an obstruction the driver knows that the rear wheels will clear also and need give them no concern.



How the Four Wheels of a Six-Wheel Automobile Are Steered

In the accompanying drawing is shown a vehicle frame having six wheels. The front and rear wheels are steering wheels, which are deflected by the steering-lever. The centrally located pair of wheels are not steering wheels and always remain in the same planes relatively to the body. When the steering wheels are deflected to steer the vehicle to the right they will follow one another in circles, while the central wheels will turn as on pivots in circles a few inches within the steering wheel circles.

The interesting features of the mechanism are the hubs of the four steering wheels, the centrally located horizontai wrist-plate with which the steering rods are connected, and the T-joints on the central axle. The hub of each steering wheel consists of a tubular body with which the driving axle is attached by a universal joint arranged in the central plane of revolution of the wheel, and permitting the wheel while receiving the rotating power of the driving axle to oscillate freely in every direction. The inner end of the tubular body of the hub engages with a sway-block having a horizontal slot sliding on the axle. This holds the wheel rigidly upright, while allowing it to oscillate to conform to the direction of motion of the vehicle.

The centrally located horizontal wrist-plate which is attached to the steering rods is composed of a cam-plate, a double cam-plate having a ball and socket bearing and numerous other accessories too intricate to describe here, all of which give to the four-wheeled steering mechanism the advantages of a sensitive and automatically locked movement in all maneuvering required in steering on ordinary straight roads, and accelerated as it approaches extreme swing right or left.

To provide for unevenness in the road it is necessary to pivot the frame at the central axle. To this end the reaches are separately journaled with T-joints on the central axle, which permits any individual axle to move vertically and yet maintains the axle rigidly against lateral movement.

Plenty of Room for All Europe

THE United States can swallow all of Europe—area, population and all—as will be seen in the accompanying map, which shows in a vivid manner how wide is the expanse of the country we live in.

The entire combined computed area of the foreign countries noted on the map and the area of the western United States are very nearly the same. The discrepancy is a bare fifteen thousand square miles on Europe's side. At the same time, however, Russia in Europe would spread over the whole western part of our country, crowding it to the doors with its one hundred and eleven millions of people, being the largest of all the European countries.

The State of California has ample quarters for seven European countries, but its population is only a little over two millions, whereas little Roumania alone harbors just about seven million inhabitants.

Austro-Hungary fits rather tightly across the shoulders in Texas, which has a scattered population of nearly four millions, whereas Austro-Hungary has more than fifty-one millions of people accommodated within its boundaries.

More striking, however, is corpulent Idaho with its three hundred and twenty-five thousand inhabitants living in an area sufficient to quarter sixteen millions of Europeans living in four large countries. Then there are Montana and North Dakota with their nine hundred thousand people enjoying enough room for Spain and Portugal's twenty-five millions.

A Map Showing How Snugly the Different European Countries Would Fit into the Western United States, Mighty Russia Occupying As Much Space As All the Other Countries Combined

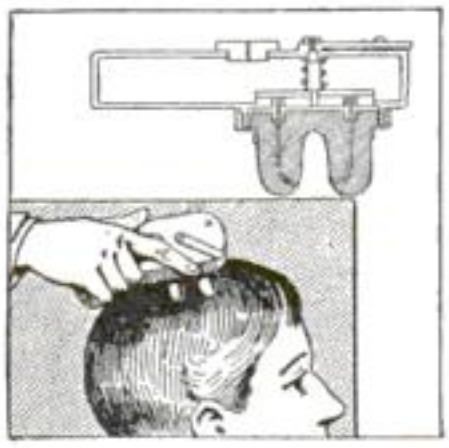
New American Porcelain Utensils a Result of the War

ONE of the results of the war was the stoppage of the importation of laboratory porcelain, and this has resulted in the manufacture of laboratory porcelain in this country, which has stood the hydrochloric acid tests equally well with that manufactured by the royal Berlin pottery in Germany, which until now has been regarded as the standard.

The cooking porcelain ware is being produced in ivory, white, brown betty, and olive green, plain and decorated, and for private ward work the pretty decorations and delicacy of the ware make the porcelain highly attractive.

Escaping the Barber's Fingers

HENCEFORTH the barber can keep his fingernails to himself. This fingertip infiltrator, which is nothing more than four rubber fingers with passages leading to a miniature reservoir from which oil and other shampooing liquids can be freely and sanitarily applied to the scalp, does away with all the dangers of infection both to barber and patron.

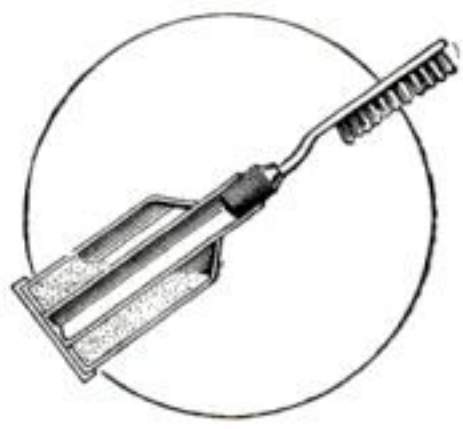


A Pipe with a Cleaning Wick

A NEW tobacco pipe has a removable perforated diaphragm or floor for holding the tobacco and ashes and keeps them away from the bottom of the bowl. A wick extends below the diaphragm into the space where the nicotine and liquid substances collect and leads to the top of the bowl to absorb such substances and prevent their passing into the stem.

Collapsible Tooth-Brush Case

A RECENT invention is a toilet case which is a combination of a tooth-brush and a container for tooth powder or other dentifrice. The pocket for the dentifrice is a concentric casing having a discharge opening and a perforated cap. The tooth-brush is collapsible and fits snugly into the central portion of the case. It is readily adjusted for use and the case is of convenient size for carrying in the pocket. It locks securely.



A Detachable Massage Brush

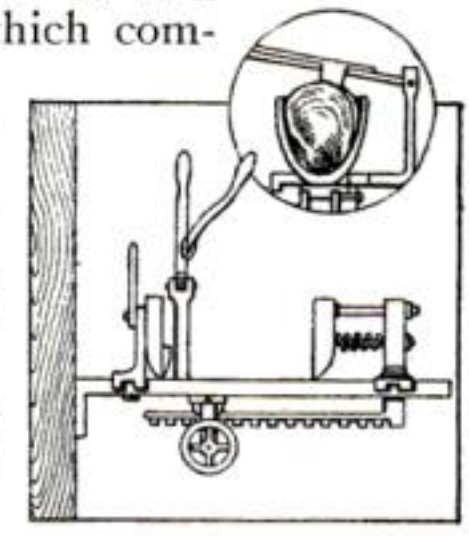
THE invention pictured in the accompanying illustration is a specially-constructed massaging device which is designed to be attached to shaving brushes. It is easily detachable and is as readily secured in its operative position when needed. It is provided with a guard which will prevent the possibility of soap and water getting on the massaging fingers and possibly contaminating the surface.

Keeping the Baby's Bottle Just Right

THE accompanying illustration shows a water bag so constructed that an infant's nursing bottle can be accommodated within a central opening and its contents kept at the desired temperature. To keep the bottle warm, the bag is filled with hot water, while during the summer season it may be packed with chopped ice or filled with ice water and will prevent the milk from souring.

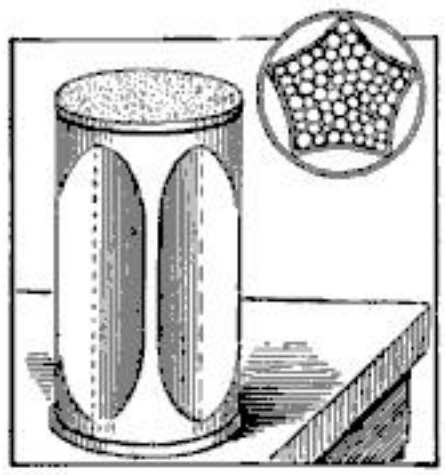
A Mechanical Oyster-Opener

NOT so picturesque, perhaps, as the old seaman who usually poses in illustrations of expert oyster-openers, the mechanical device for the purpose recently invented will nevertheless meet with appreciation. It is a simple machine which comprises a hand lever pivotally mounted, which carries spreading jaws. It can be operated by any one without danger of injury to the hands and does the work quickly.



Holding Asparagus in the Can

AN asparagus can which, when hermetically sealed under vacuum, will collapse inwardly and thus increase the gripping action of the can on the asparagus, is an improvement on the glass jars and tin containers in use at present. On account of the flat-sided or paneled construction of the can the asparagus is prevented from rotating. The inside of the can is lacquered to resist the attack of acids on the tin.

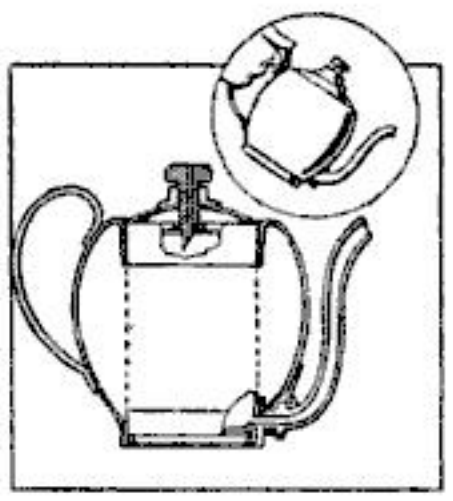


Reducing Eye-Strain

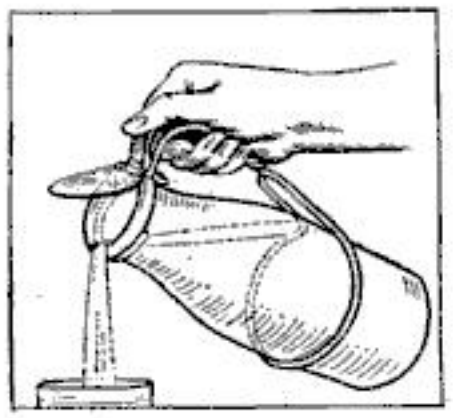
TO save the human eye from unnecessary strain, to conserve the indirect vision and relieve the muscular spasm, a mechanical concentrator closely resembling a pair of spectacles or goggles has been invented. Instead of lenses the device has two variable iris-diaphram shutters to control the extent of the openings through which the object is to be viewed and to exclude everything else from the direct line of vision.

Adding Dignity to Condensed Milk Cans

A CALIFORnia man has devised a tea-pot as an improved sanitary holder for cans containing liquids such as condensed milk and the like. Discharge and vent openings are arranged in the pot so that the liquid may be conveniently poured. The can is held rigidly in position by sockets. Before placing the can in the pot an outlet hole is punched in the bottom and a vent hole in the top.



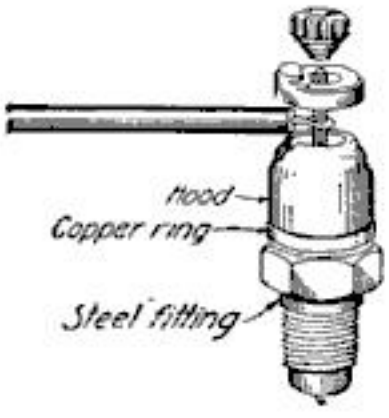
Handle and Cover for Milk Bottles



A HANDLE and cover for milk bottles and other like containers consists of a device that may be quickly and easily applied to the bottle and as quickly detached. With it the bottle may be held in any position and the liquid poured. An added feature consists of a cover which is adapted to overlay accurately the bottle top. A rearwardly projecting thumb-piece enables the user to lift the cover at will.

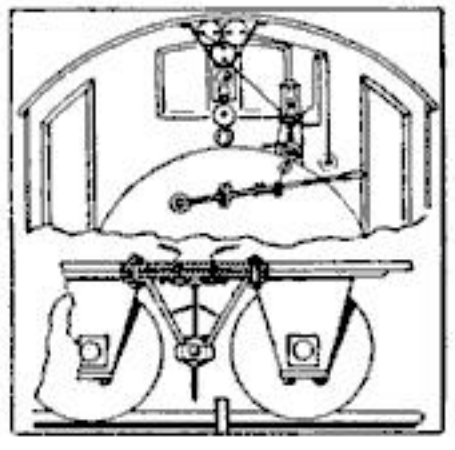
Putting Exhaust Gases to Work

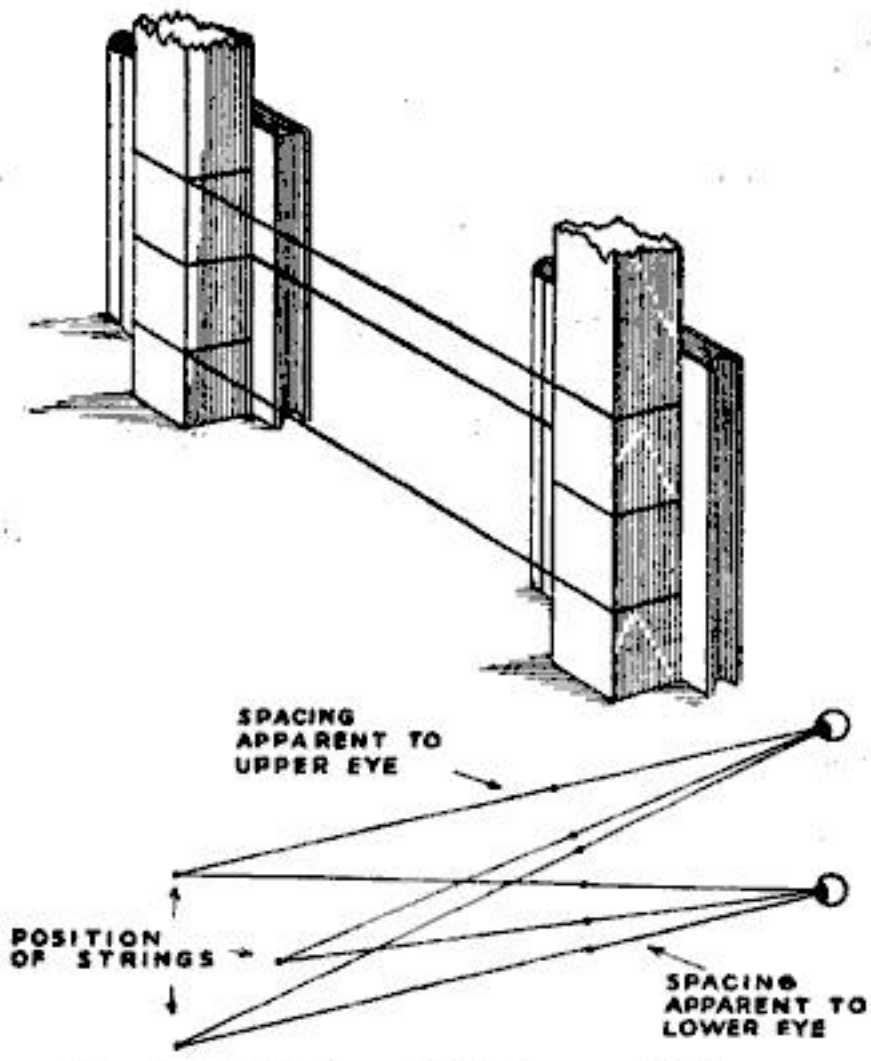
DIFFERING from all other spark-plugs, this new device relies on the whirling motion of the exhaust gases to remove carbon particles from the electrodes as soon as formed. One of the electrodes is shaped like a propeller, lying horizontal. The other electrode is a round rod in the center of the propeller-disk electrode. The gases are exhausted from the spark-plug recess with such force as to whirl them around and between the two electrodes, carrying all carbon particles with them.



Stopping Trains Automatically

A COMBINED signaling and stopping device for locomotive engines enables the engineer to receive all signals directly from a lamp in the cab, and in the event of danger ahead throws into operation a lever which automatically closes the throttle valve, stopping the engine. A system of trip levers on the railroad track comes in contact with a lever mounted between the trucks of the locomotive, closing an electric circuit and operating the entire mechanism.





Spacing of Strings Will Appear Different to Each Eye When Head Is Tilted

The Reason Why We Have Two Eyes Spaced Apart

IN the March issue of POPULAR SCIENCE MONTHLY there appeared an article explaining why we have two eyes which showed how the possession of two eyes gives us stereoscopic vision. To this might be added the explanation of another important provision of nature growing out of it, namely, why the eyes are spaced apart on a horizontal line instead of one above the other. If we look at several strings or wires spaced apart and running horizontally across the line of vision as, for example, a group of telephone or telegraph wires stretched horizontally, they will appear to lie in the same plane and all the same distance from the eyes, but upon tilting the head to one side so as to bring the eyes one over the other, the wires will appear in their true relation to each other and to the eyes.

With two eyes our stereoscopic vision is limited to the dimensions running parallel to the plane of the eyes; in other words, the horizontal dimensions of objects and the horizontal spacing between them. As this limitation is unavoidable, the advantage of having the eyes spaced apart in a horizontal plane, so that the stereoscopic effect will reveal the horizontal relation of objects, will be apparent when it is noted that most things in nature, lying in the path of travel, are horizontally spaced apart, such for example as trees, men and beasts walking on the same level and the vertical edges of taller objects. We are seldom called upon to avoid objects by passing over or under them.

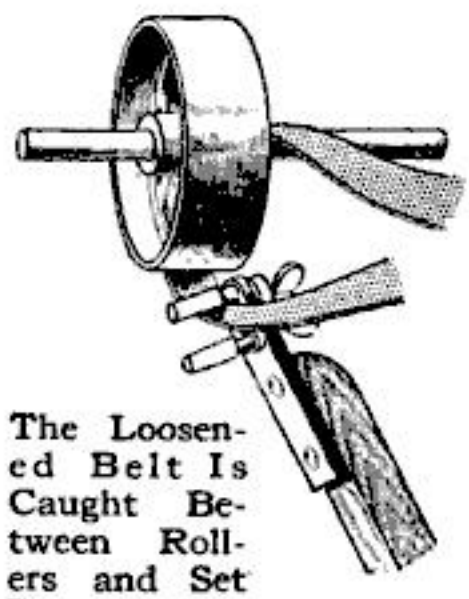
To this line of thought might also be added the conclusion that perfect stereoscopic vision in all planes is attained through a third eye positioned above and equidistant from the first two, but this, being of little necessity to our safety, nature has not provided, and its omission can be somewhat compensated for by tilting the head to one side, a thing which we often see people do.

A simple way to verify this is to tie a few strings to the legs of a chair as indicated in the above sketch, with some strings to the front and some to the back of the legs and the points of contact hidden from view. The diagram explains how the spacing of the strings will appear differently to each eye when the head is tilted to bring one eye above the other, giving a stereoscopic effect, but with both eyes on the same level, as for example the upper one, the spacing will appear the same to both.

Belt Shifter Protects Workmen

FOR preventing some of the serious accidents that are caused by workmen shifting belts rapidly, a Bridgeport company has brought out a belt shifter operating on a new principle.

Tapered rollers project from the end of a pole. The loosened belt is caught between these rollers and forced back on the pulley. By having the rollers tapered, the belt automatically works toward their bases. This feature prevents the belt flying outwards and possibly entangling the workman, with disastrous results.



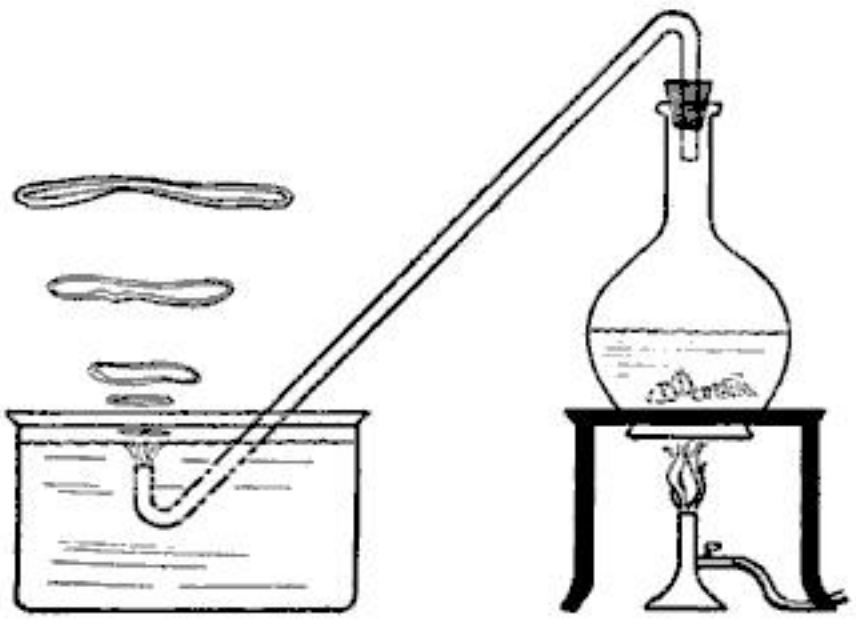
The Loosened Belt Is Caught Between Rollers and Set Back on the Pulley

Spontaneous Combustion

IT is not difficult to understand how combustion may take place without any *apparent* cause. Consider some of the everyday examples of combustion. Coal requires a considerable amount of coaxing before it will ignite, hence the necessity to lay a fire with wood to start the coal and paper to light the wood. A poker at a bright red heat will ignite a gas jet; upon cooling to a dull red heat it will set fire to paper; and after still further cooling will explode gunpowder.

Phosphorus takes fire at a little above 100° F., by no means a high temperature. But the vapour of liquid phosphuretted hydrogen is even more easily inflamed, requiring for its ignition a temperature less than the ordinary temperature of a room. Hence, whenever this substance comes into contact with the air it takes fire at once. This is an example of so-called spontaneous combustion, and only differs from the combustion of a candle in the circumstance that no outside source of heat is required to start the reaction.

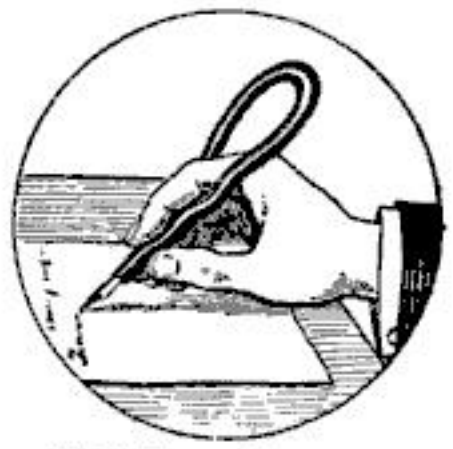
Phosphuretted hydrogen can be made by placing small fragments of yellow phosphorus in a flask together with some quicklime and covering with water. Upon boiling the water phosphuretted hydrogen is formed and escapes from a bent glass tube passing through the cork, the other end of the tube dipping below the surface of warm water contained in a dish. As each bubble of gas comes into contact with the air it takes fire and forms white powdery phosphorous pentoxide.—H. T. GRAY.



The Phosphorus Powder Produces a Series of Smoke Rings which Expand as They Rise

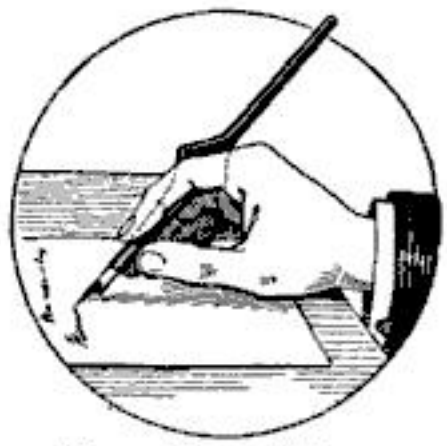
Fitting Penholders to Crippled Hands

AMONG the many appliances which have been devised to lessen the care of soldiers injured in the war are various kinds of penholders for those with crippled hands. If the thumb and forefinger or the forefinger and middle finger are stiff, or even if all three fingers are not capable of bending, a holder in the form of a loop may be successfully used. This arrangement, in which the control is shifted back into the hand, is shown in Fig. 1.



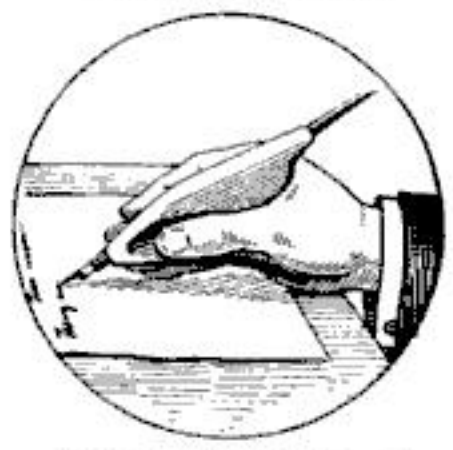
This Loop Arrangement Shifts the Control Back Into the Hand

If the thumb, ring finger and little finger have been amputated, a holder like the one shown in Fig. 2 is of service. The enlarged portion enables the index and middle fingers to grip it securely and also keeps the holder from turning.



For Use Where Thumb and Two Last Fingers Have Been Amputated

When the thumb is good, but all four fingers injured so that only their stubs are left, a triangular block is made that fits the palm of the hand on one side, and has a groove for the thumb on the other side. A firm grasp can be obtained by pressure with the thumb. This device is shown very clearly in Fig. 3.

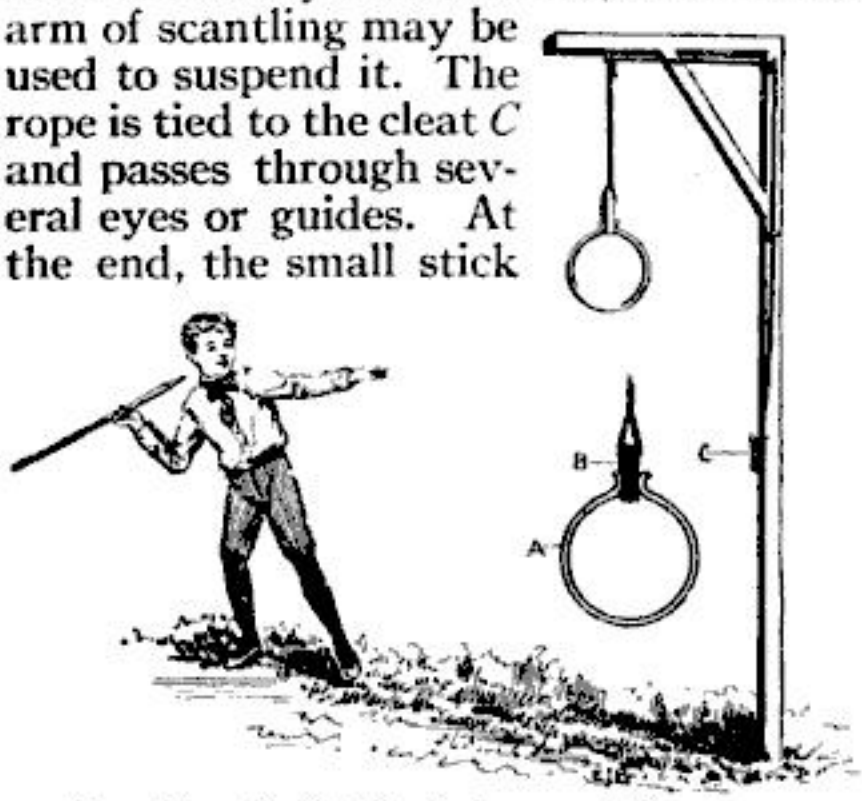


When the Hand of the Injured Trembles While Writing

Casualties are so varied that no standard device can be established. Some are injured in such a way that their hand trembles when writing. A thick holder of wood or cork, which only requires holding but no bending with the fingers, is very successful in this case.

A Fascinating Old Sport in a New Dress

AN interesting outdoor game may be evolved from the simple act of tossing a wooden spear at a moving ring. A conveniently located tree, or a cross-arm of scantling may be used to suspend it. The rope is tied to the cleat *C* and passes through several eyes or guides. At the end, the small stick



The Ring Is Set Swinging and the Spear Is Tossed Through It From a Distance

B is tied. The ring *A* is a piece of spring wire which snaps on to the stick. The spear is a broom-handle or straight pole with one sharp end. The ring is set swinging with a gentle pendulum-like motion and the one about to test his skill endeavors to toss it through. If it touches the ring another trial is allowed, and if it passes through cleanly ten points are scored. As skill increases the throwing distance may be lengthened. After passing through the ring one point is scored for every five feet the spear travels. If it is of this length it will be easy to measure and count the points. The sport is fascinating and admits of much variation in scoring.

Tracing Magazine Cuts

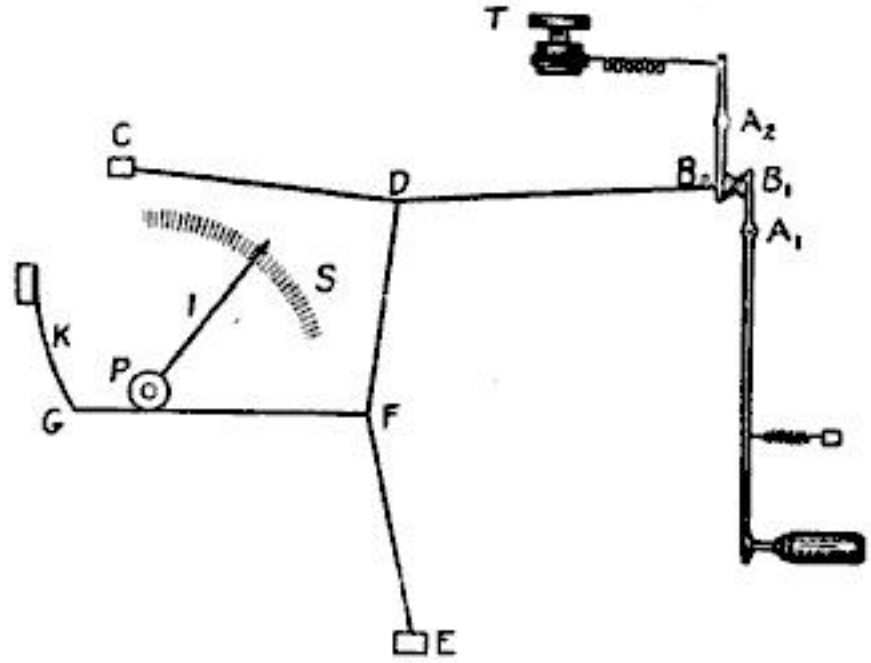
THE cut is traced on a clean, unused sheet of carbon paper with a sharp pencil. The prints are then made from the carbon sheet; they will be blue lines on a white background. By this method it is possible to pencil additional notes on to the print. The carbon sheets can be used as long as necessary and then renewed by holding them against any hot surface such as an electric globe. This will melt the carbon preparation and soon cover all the lines.

Measuring Ten Thousandths of an Inch

THE accompanying illustration shows the essential parts of a micrometer designed to indicate on a scale *S* the thickness, in thousandths of a millimeter (one millimeter is about one twenty-fifth of an inch) of any small object placed between two tempered steel blocks, B_1 and B_2.

In using the instrument the blocks B_1 B_2 are first brought together without obstacle, and then the micrometer screw is turned in one direction or the other until *I* stands at zero on *S*. A button is then pressed to turn the lever about the pivot *A* and permit introduction of the body to be measured between B_1 B_2. The screw *T* is then rotated as far as necessary to make the spring exert a suitable pressure on the piece between B_1 B_2.

Between the block B_2 and a fixed block *C* there is stretched a wire between the center point of which and a second



Essential Parts of a Micrometer That Indicates Thickness in Thousandths of a Millimeter on a Finely Balanced Scale

block *E* there is stretched a second wire *DE*. The wire *FG* is attached to the center of *DE* and, after passing round a pulley *P* on the point spindle it (*FG*) is anchored to a plate spring *K*. The latter keeps taut the wires *GF*, *ED* and B_2 *C*, hence as B_2 moves to the left (when a piece to be measured is introduced between B_1 B_2 or the zero of the instruments is adjusted), the slack in B_2 *C* is taken up by the sag of the wire being increased. Slack thus produced in *DE* is taken up by increased sag at *F*, the spring *K* meanwhile moving to the left to take up slack in *FG*.

Experimental Electricity

Practical Hints for the Amateur

Wireless Communication

A Microphonic Amplifier

By Arthur Ellison

THE amplification of radio signals is receiving much attention. For this purpose nothing is superior to the audion amplifier, but the price of this apparatus places it beyond the reach of many amateurs.

The microphone amplifier herein described will do remarkable work when properly adjusted, but it *must* be kept free from vibration. The easiest way to do this, and perhaps the best, is to place several layers of felt under the base, or, if possible, to mount it firmly on a solid brick wall. Small, soft rubber feet under the instrument are also of some assistance in cutting out undue vibration.

In the accompanying drawing at Fig. 1 is shown the electromagnetic microphone complete. It consists of two 1,000-ohm telephone receivers mounted on a base in a vertical position.

The receiver shells are drilled and tapped to admit two small machine screws which fasten them to the brass angles. The support on the left is a plain *L* with a hole in the bottom part to clamp it to the base, but the other *L* is somewhat different in shape and is shown in detail in Fig. 40. As will be readily understood, it is slightly shorter than the first named, and is turned up at the end so the thumb screw will act on it. A slot is cut in the bottom part so that the receiver may be moved forward or backward by operating the thumbscrew, and a spring is arranged to push it back normally.

In the center of each of the diaphragms is mounted a small carbon button. These are only about ¼ in. in diameter and are shown in detail in Fig. 2. A conical hole is drilled in one face and a slot cut with a fine saw on one side. A very thin flexible wire is laid in this slot and solder poured in to hold it there. By twisting the saw while cutting the slot, the slot will be made wider at the bottom, and the solder will hold the wire in place.

The carbon buttons are fastened to the center of the

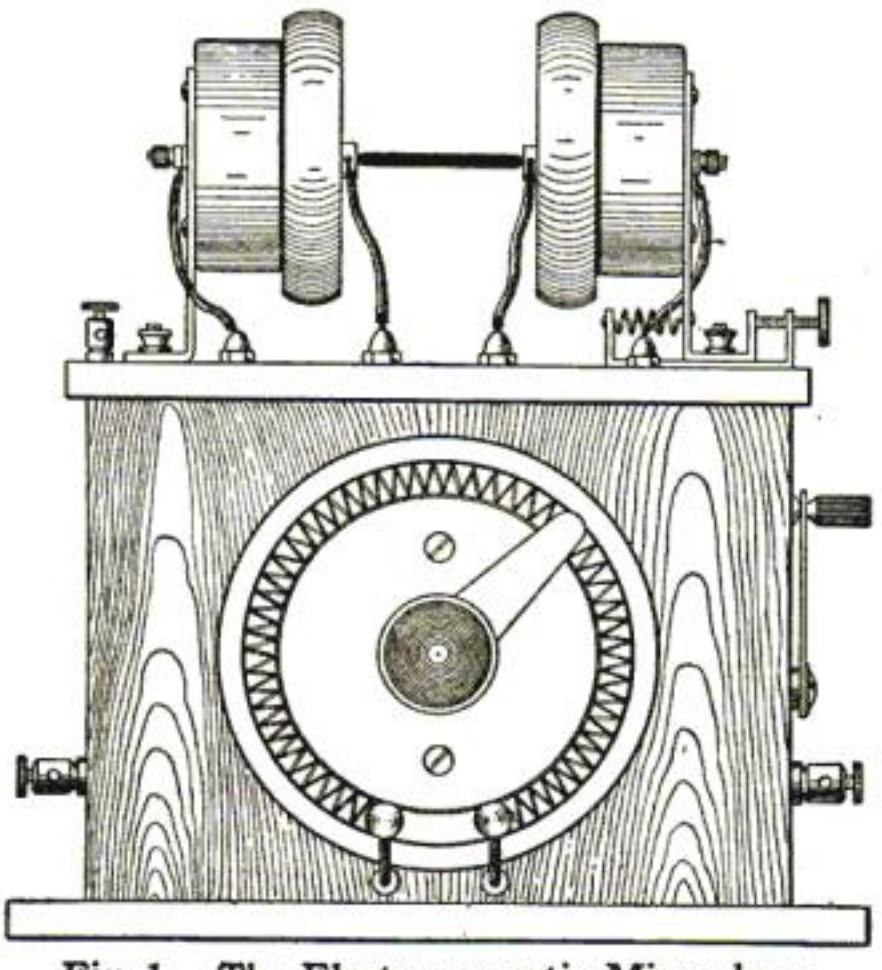


Fig. 1. The Electromagnetic Microphone Complete and Mounted in Position

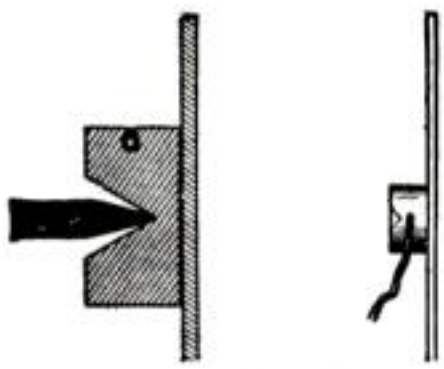


Fig. 2. Carbon Button in Center of Each Diaphragm

diaphragm with shellac. They should be placed in a hot oven to insure the complete evaporation of alcohol in the shellac, and thus hold the carbon firmly to the diaphragm.

The receivers are mounted so their faces will be about 2 ins. apart and connected in series to two binding posts at the left of the base. The thin flexible wires from the carbon buttons are also connected to two binding posts. A neat method of running the connection from these wires through the base makes use of cap nuts as detailed in Fig. 3.

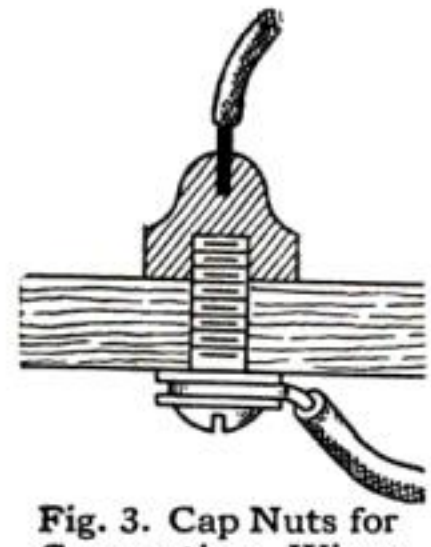


Fig. 3. Cap Nuts for Connecting Wires Through Base

The batteries and switches are wired as clearly shown in Fig. 5, the binding posts marked A^1—A^2 being on the left side of the box and those B^1—B^2 on the right side. This completes the amplifier, with the exception of the loud talking receiver which is connected to B^1, B^2.

The loud speaker can be made from an ordinary 75-ohm telephone receiver of the kind that sells for about 40 cents. The fine wire is removed by cutting or unwinding and heavier wire put in its place. The receiver should then be rewound with about No. 42 wire, to a resistance of approximately 14 ohms.

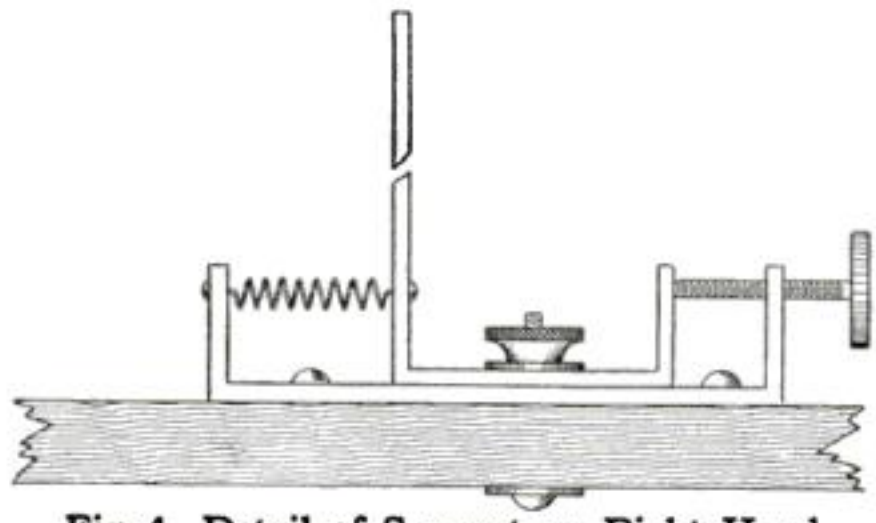


Fig. 4. Detail of Support on Right Hand Side with Thumbscrew Regulator

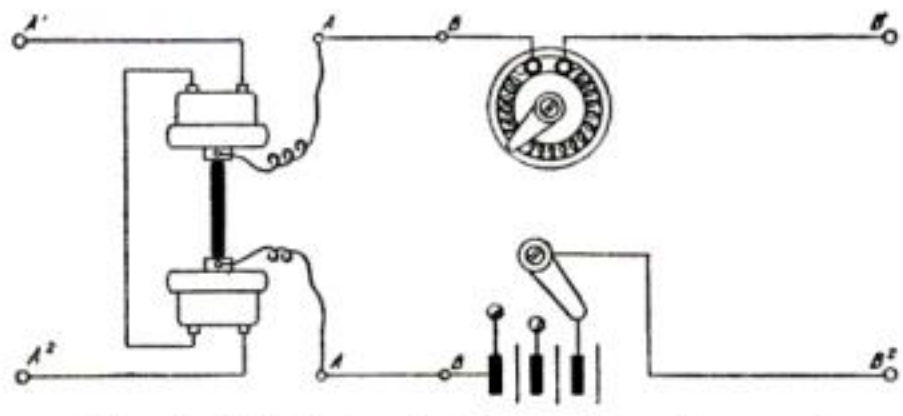


Fig. 5. Method of Connecting Posts of Microphone to Posts of Control

A hard pencil should now be boiled in water till the wood comes off and the lead is left whole. Cut off a piece a trifle longer than the distance between the receivers when the one at the right is adjusted about to the middle of the slot. This lead is carefully sharpened to a point at each end. The point should not be too sharp, for if so it will break off when a little pressure is applied.

The pencil lead is now to be slipped into position by backing out the right hand receiver and placing the ends of the rod in the cavities in the carbon buttons. This completes the microphone.

A good arrangement for controlling the apparatus is shown. A wood box is constructed large enough to contain three standard dry cells. Smaller batteries may be used but they will not last as long. On one side of the box is mounted a four-point switch (Fig. 1) and a small finely adjustable rheostat is mounted on the front.

After rewinding the receiver a short piece of brass tubing 1 in. in diameter and 2 inches long is fastened to the cap of the receiver. Obtain two pieces of brass tubing that will just fit over this tube with a good sliding fit. These pieces are to be 2 ins. and 4 ins. long respectively, and form a variable acoustic resonator.

The binding posts of the receivers on the microphone are connected to the receiving set. The posts A—A of the microphone are connected to the posts B—B of the control box while the loud talker is connected across posts B_1—B_2 (see Fig 5.)

An extra 1,000-ohm receiver should be connected in series with the telephones actuating the microphone, to test the adjustment of the detector. A switch may be arranged to short circuit this additional receiver when it is not required.

Constructing an Amateur's Aerial

By K. B. Warner

The following contribution won the first prize in the Popular Science Monthly's Radio Prize Article Contest which closed on June 15th. We would call it to the attention of our wireless friends because both in subject matter and in method of presentation it is the kind of radio material that we want to encourage. The article that won the second prize will appear in the October issue. Its subject is "Cures for Trouble in a 200-Meter Wave Outfit."—EDITOR.

THE construction of amateur radio apparatus has been very fully covered in the past few years, but there is a noticeable dearth of data concerning the erection of amateur masts.

Fortunate, indeed, is the amateur who is located so that a mere "2 x 4" on house or barn will furnish a pole of good height. There are many of us not so located, however, and the design and erection of an eighty-foot pole which the writer put up at a moderate expense are here set forth in hopes that the information will prove of value to amateurs whose range would be greatly increased if their aerials were swung higher.

A sketch of the complete pole is shown in Fig. 2, from which it will be noted that it consists of a timber, *A*, and three sections of pipe, *B*, supported by guy wires at each joint. The timber is provided with an iron collar at the top, through which the pipe is raised; and a small platform 6 feet from the top, from which the work of erection is conducted.

Details of the Timber

In Figs. 7 and 3 are shown the details of the timber, which is preferably a 6-inch by 6-inch, long enough to stand 28 or 30 feet out of the ground. The length imbedded in the ground depends on the nature of the soil. If good hard ground, the ideal way is to imbed it in concrete. In the writer's case, hard clay was struck at about 4 feet, and a buried platform 3 feet square, as shown in Fig. 1, provided ample bear-

Fig. 1. The Foundation

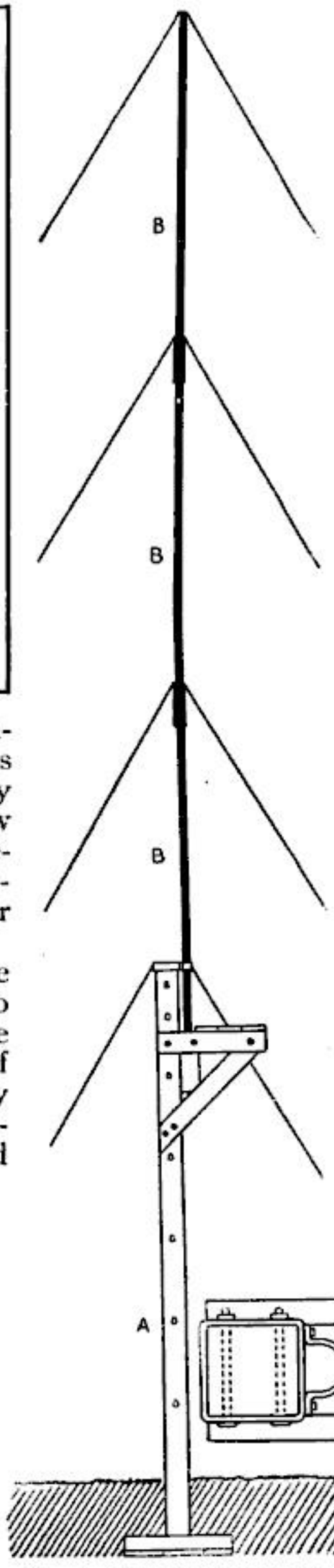


Fig. 2. The Mast Complete

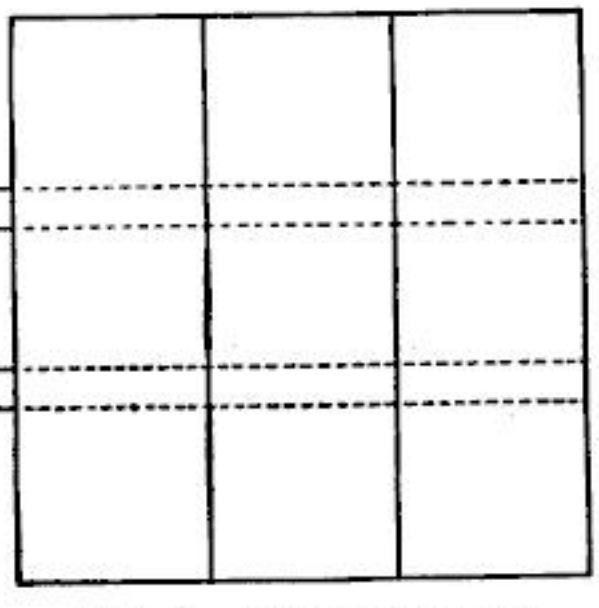


Fig. 3. Top of Platform

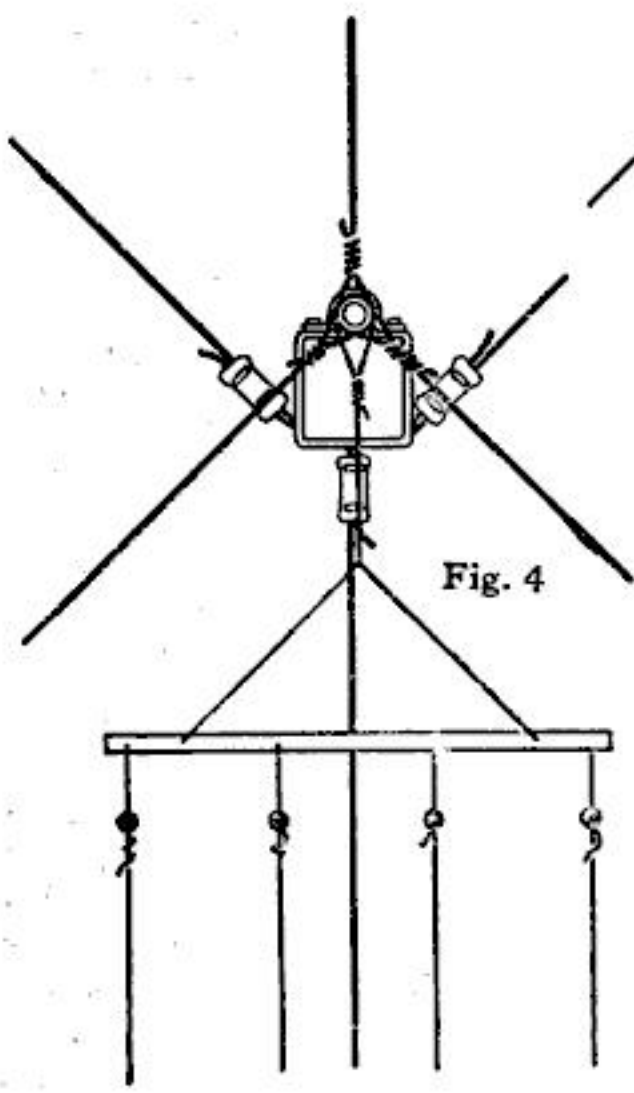


Fig. 4

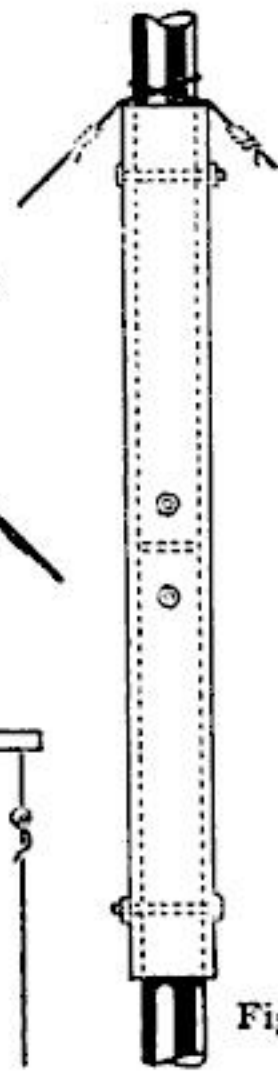


Fig. 5

Fig. 6

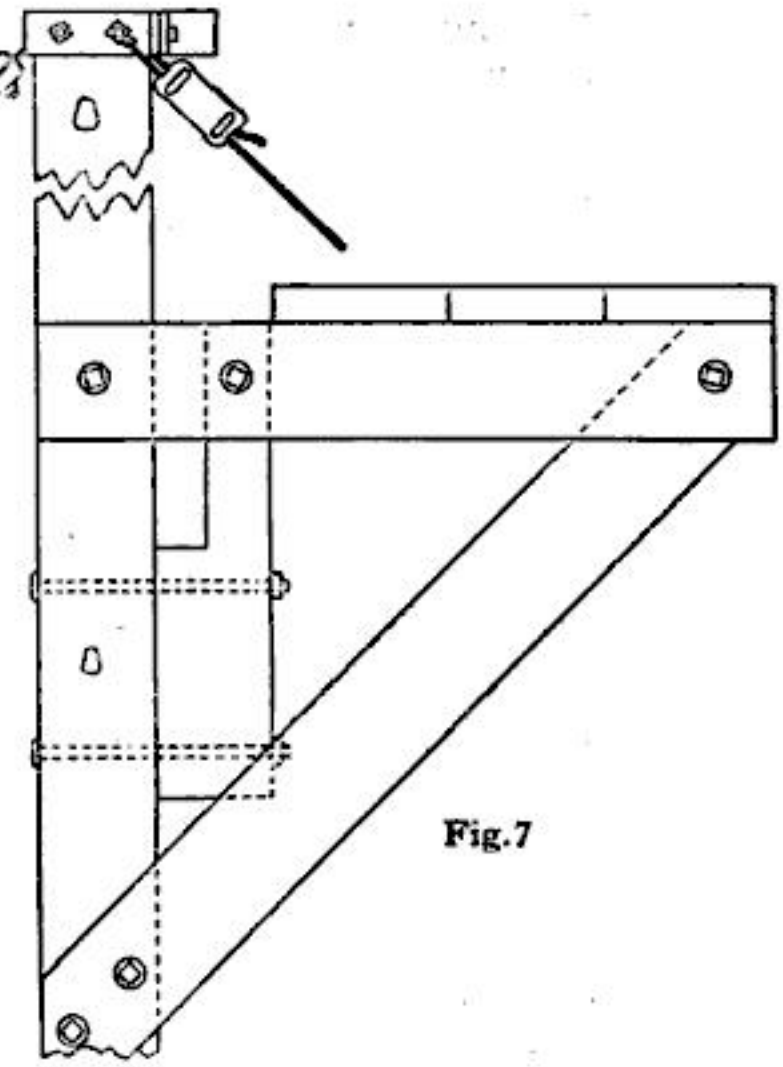


Fig. 7

Above (Fig. 4), is shown the general guy plan. At left (Fig. 5), is the method of joining pipe sections and attaching upper guys. A good joint is made by butting the ends together and bolting through a sleeve consisting of a 2-foot length of pipe just large enough to slip on. The design as shown is flexible and additional sections of pipe may be added, if desired. At center (Fig. 6), is a view of the base block to hold pipe. At right (Fig. 7) is a side view of wood pole, showing platform and iron loop

ing. Details of the iron collar are shown in Fig 3. This should be made of ⅜-inch by 2-inch strap iron. It has a loop securely riveted on it, made of the same material, of such dimensions as to pass a pipe 2 inches in outside diameter. Fasten this collar securely to the top of the timber with lag screws. It is also to be drilled for securing the guy cables.

The platform on the mast is 2 feet square, supported on two pieces of 2-inch by 6-inch, bolted to the timber; the details are clearly shown in Figs. 2 and 3 of the illustration.

Note that a space 6-inch by 6-inch is provided alongside the timber and between the two supports. Standard pole steps are provided and the woodwork is given two coats of mineral red paint, and the portion to go underground is preferably tarred. The pole is then raised in the excavation beforehand provided. It should be securely guyed by three 7-strand ⅜-inch cables affixed to the iron collar, and trued up by means of turn-buckles.

We are now ready to proceed with the erection of the pipe, which is composed of 20-foot lengths of standard 1 ¼-inch galvanized well-pipe. Black pipe of the same size, if given two coats of aluminum paint, will be found very satisfactory for the purpose.

Do not use pipe unions between joints, as they are not strong enough. A good joint may be made, as in Fig. 5, by butting the ends together and bolting through a sleeve consisting of a 2-foot length of pipe just large enough to slip on.

Erecting the Pipe

Erection is accomplished as follows: The top piece of pipe is inserted through the 6 by 6 opening in the platform supports, and through the loop in the iron collar, and temporarily suspended so the top is just a few inches above the collar.

Aerial pulley and rope are fastened with an eye-bolt through the end of the pipe, and the top set of three galvanized No. 12 gage iron wires secured around

the pipe above the bolt. From his position on the platform, the erector can easily raise the pipe hand over hand until it is high enough to couple on to the second section in the manner shown in Fig. 5. The two coupled sections are then raised until the coupling is just above the collar, where they are temporarily suspended by a hook inserted in the bottom pipe, and the second set of three guy-wires attached.

Handling the Guy-Wires

From this point on it will be necessary to enlist the services of neighbors to hold and pay out guy-wires. The two sections are raised in the same manner high enough to couple on the third section. After this it will be necessary to resort to block and tackle. A good way to use this is shown in Fig. 8, in which it should be noted that the temporary arm, made of two 5-foot pieces of 2-inch by 4-inch, straddles the pipe and is securely guyed in its position at the rear.

The pressure brought to bear on the arm is all downward, and a few nails through a block between the members will hold it in place temporarily. Tackle is rigged between this arm and a single block in the bottom of the pipe, and the three sections of pipe are easily raised. The third set of guy-wires is to be attached as soon as the last joint gets above the collar.

Bolting the Pipe in Place

The bottom of the pipe is fastened to the side of the pole at the height of the platform, by resting it on the block shown in Fig. 6. This may be of 6-inch by 6-inch cypress, 2 feet long, and is hollowed out on the side next the pole to receive the pipe as shown. It is securely bolted to the platform supports and the timber as indicated. A rope hitch around the pipe serves to lower it gradually into the hole, after which the guy-wires are trued up and the mast is complete.

In Fig. 4 is shown how the guys may be spread in six directions. It will be found very desirable to break the guy-wires up into short lengths to prevent absorption of energy. Ordinary porcelain knobs are quite satisfactory for this purpose. Buried logs make excellent guy anchors; they should be set well out from the base of the pole.

The Mast Will Resist Storms

This makes a strong, serviceable, neat-appearing mast. The writer has one, erected over a year ago. Standard couplings instead of pipe sleeves are used between the joints, which support a heavy 200-meter aerial made of No. 9 solid copper wires. It has successfully withstood several 60-mile squalls, besides some exceptionally heavy sleet storms.

Fig. 9. Top View of Temporary Arm Rigging. This Arm Straddles the Pipe and is Securely Guyed at the Rear

Fig. 8. Showing Rigging of Temporary Arm for Final Lift

The design herein set forth is of course flexible, and the builder can easily add an additional 20-foot section of pipe if desired.

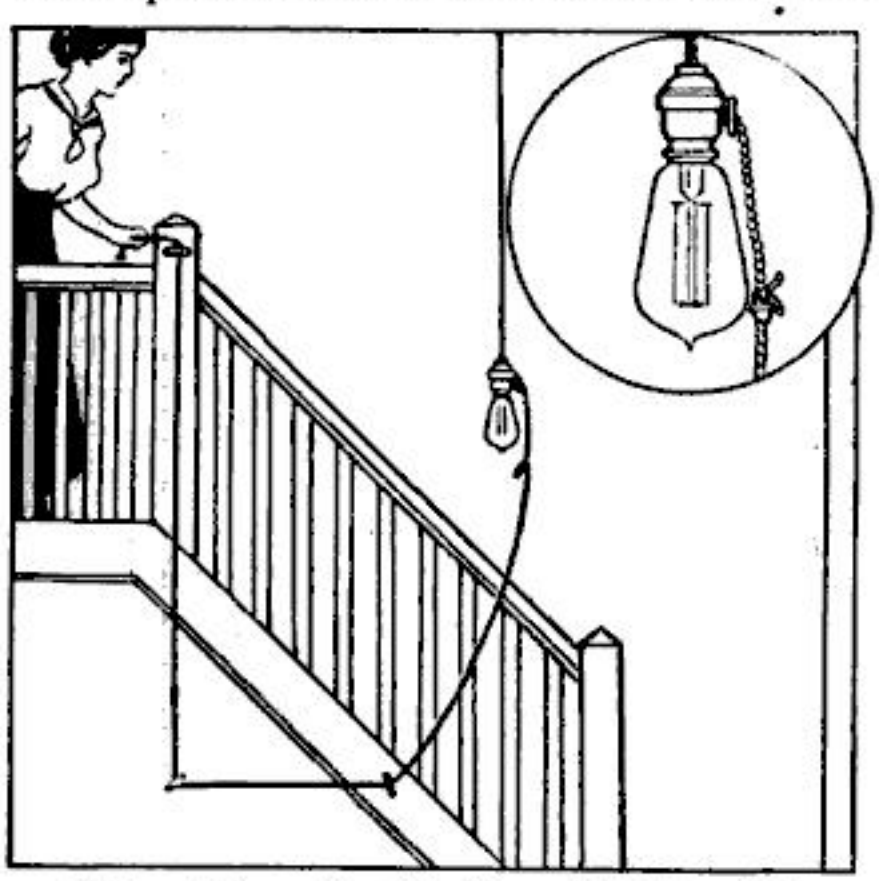
The round pipe offers much less resistance to the wind than wood timbers of equal strength, and as it is well insulated from the ground, there is little or no loss from this cause.

It would be well to provide a grounding switch for lightning protection on the side of the timber near the ground, connected with the pipe by a heavy copper wire, but this is not absolutely necessary.

A Convenient Arrangement for Turning on the Hall Light

WHILE nearly all new buildings are wired so that the hall light can be turned on and off from either floor, the older buildings do not have this convenience. The cost of installing cross switches is considerable, but an arrangement that will serve the purpose can be installed at slight expense.

Get a chain socket for the lamp. Tie a cord to the chain, run it through two eyelets as shown in the sketch, and fasten the other end of the cord to the newel post at the head of the stairs. The



Where There Are No Cross Switches This Method of Control Will Answer

entire cost will be fifty cents for the chain socket. If you do not care to put screw eyes in the woodwork, loops made from heavy wire can be tied to the banister rails. Any other method of conveying the cord to the newel post might prove equally as satisfactory and inconspicuous.—E. F. AYRES.

Guying the Mast

IN putting up an aerial, one very essential feature, seldom mentioned by the authors of experimental wireless books, is the necessity for a strong brace at the top of the mast. It is a good plan in erecting a mast, to adjust a guy wire so that it will pull back directly against the strain of the aerial. Otherwise the top of the pole will lean inward and perhaps break off.

Wiring the Ford Automobile for Magneto and Battery

WHILE the Ford owner has been impressed by the simplicity and cheapness of his magneto lighting system, he has found many serious faults. If he slows down for bad roads, the voltage drops and his lights become wretchedly dim. If he speeds on a bit of smooth road, the voltage rises and burns out his bulbs. It is then he longs for a good storage battery. However, he does not like to give up the use of the magneto. Its light is fine for city driving and ordinary travel. If he only could snap on the battery for emergencies! How can he wire his car to use both?

The difficulty is due to the fact that his magneto furnishes a twelve-volt current and his battery but six. With magneto, two six-volt headlights must be wired in series to prevent burning out. If he uses the battery, the wiring must be changed to parallel or the lamps will not receive pressure enough to light them.

He can easily solve the problem by mounting a three-pole two-throw switch on left of dash within easy reach and making connections as shown in the accompanying diagram.

When the handle is thrown up, three knife blades close the gaps *b* and connect the battery parallel with the headlights. When the handle is down, the two outer blades close the gaps *m* and connect the magneto *M* in series. *S* represents a couple of snap switches. These should both be snapped on whenever light is needed and the three-pole switch will instantly change from one current to the other—S. D. BATES.

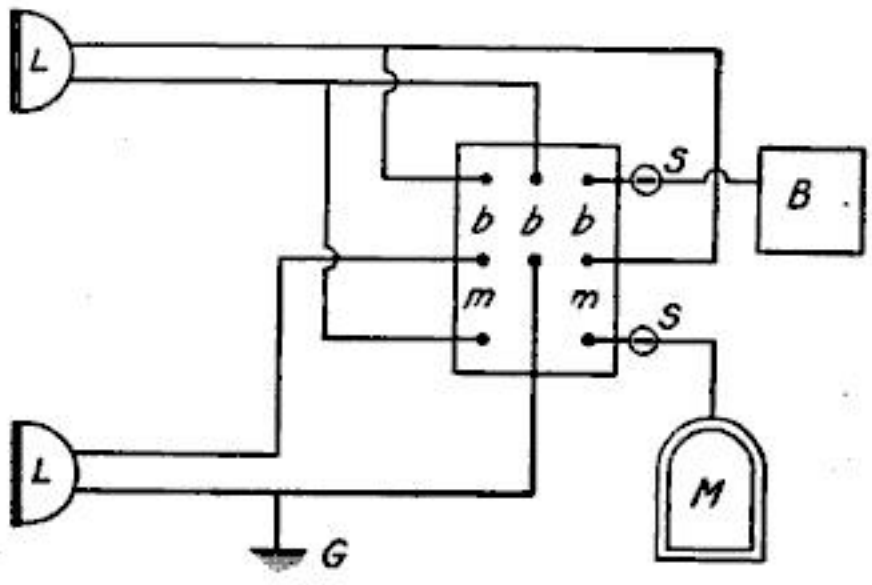


Diagram of Connection of Three-Pole Two-Throw Switch on Ford

A Simple Way to Construct a Ten-Ampere Shunt

A 10-AMPERE shunt which can be used in connection with an ammeter, either of the home-made variety or of a standard type, can be constructed with little difficulty. When used in connection with the standard ammeter it is assumed that the meter is calibrated for a much lower reading than that which is desired. Through the simple addition of the shunt, the meter may be made to measure a current several times as large as that handled without the shunt.

The materials necessary are as follows: strip of German silver, brass blocks, block of wood, screws for am. leads, screws to hold the line wires tight, screws to fasten brass blocks to the block of wood, and a hole for line wire.

First, saw two pieces of brass and file them smooth, so that their dimensions are 1 in. by ¾ in. by ¾ in. Drill holes, as shown, with a No. 25 drill, making them of suitable size for screws to hold the brass block to the base. Thread the ones for wire terminals with a 10-in. by 24-in. tap.

Secure a piece of German silver, 12 mil. thick (.012 in.) and 2⅜ ins. long, and calculate its width by the following method. In calculating the width, the length of the German silver strip is 2 ins. because the ⅜ in. goes into the brass block, 3/16 in. in each one. The ammeter reads 50 millivolts on full scale deflection.

1 millivolt = .001 volt. 50 millivolts = .05 volt; current 10 amp.

$$R = \frac{E}{I} = \frac{.05}{10} = .005 \text{ ohms resistance of the German silver.}$$

$$R = \frac{K1}{A} \qquad A = \frac{K1}{R}$$

where K is the resistivity of German silver, 1 is the length in ft., R the resistance, and A the area. The resistivity of German silver is 20 times that of copper. 10.4 = resistivity of copper. 1 = 2 ins. = .167 ft. so $20 \times 10.4 = 208$ resistivity of German silver.

$$A = \frac{208 \times .167}{.005} = 7214.5 \text{ cu. mils.}$$

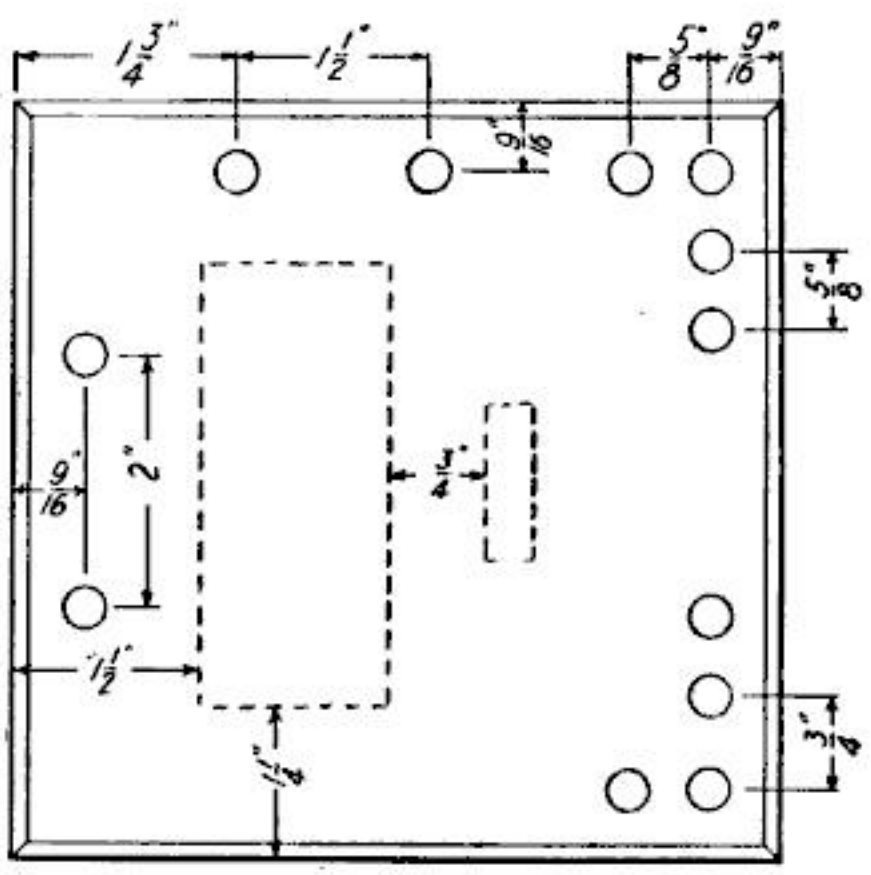
$$A = 7214.5 \times .7834 = 5666.36 \text{ sq. mils.}$$

$$A = \frac{5666.36}{1{,}000{,}000} = .00566 \text{ in.}$$

Thickness = .012 in.

$$\text{So width} = \frac{A}{TH} = \frac{.00566}{.012} = .471 \text{ in.}$$

Cut a groove in each brass block 3/16 in. deep and ¼ in. up from the bottom, and solder one end of the German silver strip in each block, as shown in the diagrams. When the strip



A Diagram Showing Dimensions and Component Parts of Shunt

is firmly fastened, file off the stray solder which may have remained on the brass blocks. Cut a block of wood 6¾ ins. by 3¼ ins. by 1⅛ ins., plane it until smooth, and then sandpaper and shellac it. When it is dry, screw the brass blocks on it in the right place, according to the dimensions given in the accompanying diagrams.

After it is securely fastened, connect two ammeters with two 10-amp. shunts, one a standard and the other the one described above, in series with a D. C. source. Pass 10 amperes through the meter with the standard shunt; and note the reading on the other ammeter. In most cases it will read a little low, because the calculations for the width of the German silver strip may be a little inaccurate. File the shunt until both ammeters read the same.

Controlling Temperature and Humidity at the Same Time

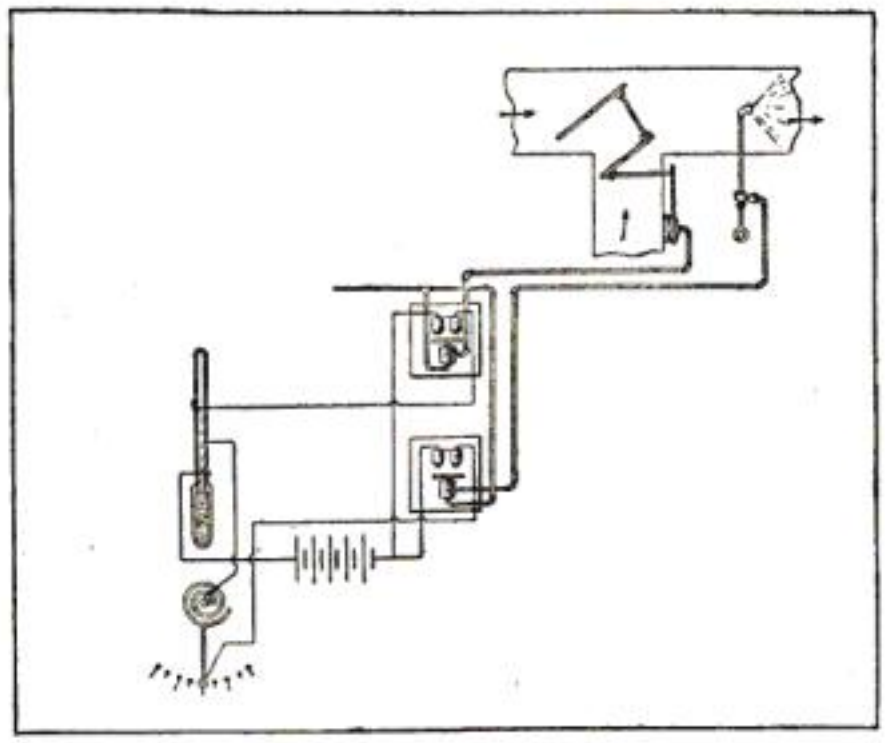
AN APPARATUS for automatically controlling the temperature and humidity of one or more spaces or rooms consists of a thermostat for determining the temperature and a hygrometer for determining the humidity, both instruments being electrically connected with a regulating mechanism. The thermostat consists of an ordinary mercurial thermometer having metallic contacts fused in its tube at predetermined points to form contact with the mercury column.

One of the contact points is at the maximum heat-point, fixed at seventy degrees, and the other is at the minimum heat-point, which is fixed at sixty-five degrees.

When the mercury touches either of these contact points a circuit is closed and the temperature of the room is regulated accordingly. The principle involved is of the simplest and its adoption ought to do much toward helping the weather man please a limited public.

The hygrometer consists of a flat helical, or spiral, body composed of a highly hydroscopic substance which assumes various shapes and more or less expands according to the amount of humidity absorbed. The helical body winds tighter or unwinds as the humidity fluctuates, and registers its movements by a dial swinging over an index. When the dial touches contact points on the index an electric circuit is thereby completed which either increases or diminishes the humidity.

In practice both of these controlling devices are connected to admit heated or cooled air to the room or space. With a rising temperature and increasing humidity circuits are closed which actuate other apparatus which in turn operate to admit cooler and drier air.

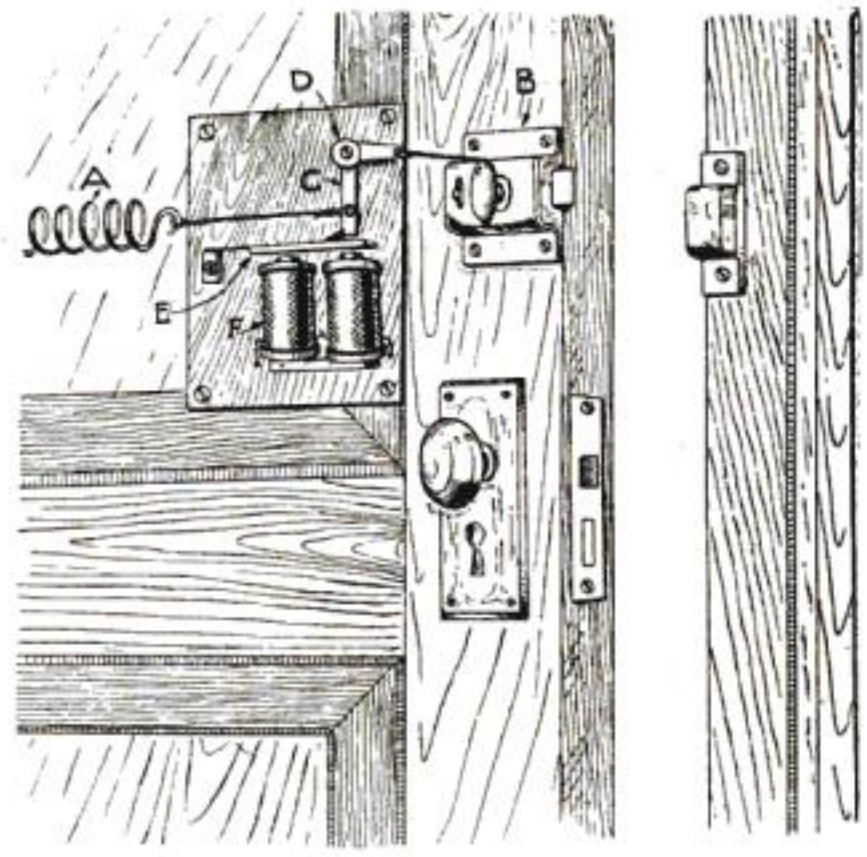


Thermostat and Hygrometer Electrically Connected with Regulating System

Electric Substitute for the Old-Fashioned Latchkey

A CONVENIENT and efficient device for unlocking any door fitted with a spring lock is shown in the accompanying sketch. A fairly stiff spring *A*, is connected by a flexible wire cord to the knob *B*. The cord is also fastened to a lever *C*, which is pivoted at *D* and is released by a magnetic trigger *E*, made from the armature and magnet of an old electric bell.

When the circuit is completed by means of a secret contact device outside the door, the magnet *F* pulls down the armature which releases the trigger and allows the spring to open the lock. If there are metal numbers on the outside of the door they may be used for the secret contact, if desired. If there are no numbers on the door, a small contact board may be constructed by driving about 10 brass-headed tacks into a thin piece of wood to make connections. Then however dark the night there will be no trouble opening the door.—WILBUR SEIPEL.



Essentials in the Arrangement for Unlocking Door Without a Key

A New Tuner Arrangement

IN building an inductive coupler, the problem of reducing the usual number of taps and switch points without losing flexibility of adjustment was solved as outlined below.

The instrument was designed to be a cabinet set. Since the space available within the case was rather limited to use, a sliding secondary coil was impractical. Hence the "static" type was adopted. Primary and secondary coils were wound on tubes of the same diameter and placed at right angles to each other to prevent induction between them. Both cylinders are 8 ins. long and 3½ ins. in diameter. The primary is wound with No. 26 enameled wire, tapped at every 22nd turn, 18 taps in all. The secondary is wound with No. 30 enameled wire, tapped at every 35th turn, 18 taps in all.

To permit of sharp tuning in the primary circuit, a small variometer was constructed. The maximum inductance of this is slightly more than a one-point variation on the primary switch (22 turns). Hence with the variometer connected in series as shown, even sharper tuning can be accomplished than with a tuner tapped to single turns. A variable condenser of .0005 mf. is shunted across the secondary for the close tuning of that circuit, and a second variable condenser of .001 mf. is connected between the primary and secondary coils, which latter controls the coupling between the two. The entire set is wired according to the diagram. Comparative tests with other instruments have proven that the hook-up here described brings in strong signals and permits of sharp tuning.—EDWIN L. POWELL.

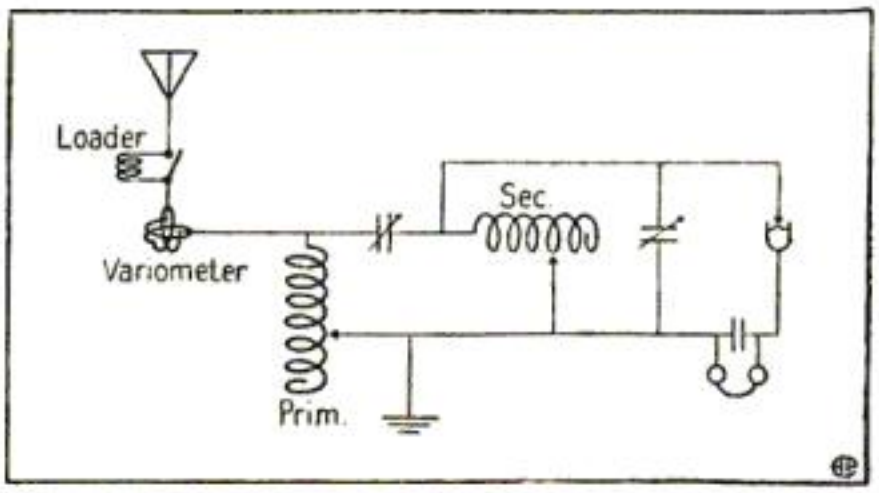
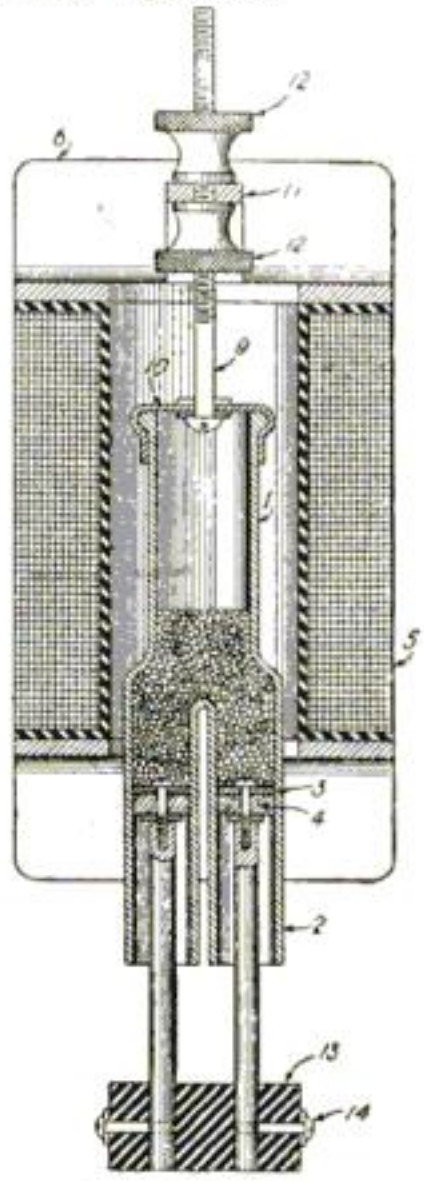


Diagram of the Wiring in the Construction of a Tuner Cabinet Set

Lepel Improves His System

AN important 1916 patent is number 1,168,837 issued to E. von Lepel for a method of producing electrical oscillations. The drawing is a reproduction of one of the eight circuit diagrams shown, and is typical of the invention. A direct current generator 2 supplies power to the condenser 1 through impedances 7 7 and resistances 6 6. The discharge of the condenser 1 takes place through the primary of oscillation transformer 5 and across the parallel-plate quenched spark-gaps shown at 12. The antenna and ground are connected to the terminals of the secondary of transformer 5.



One of the Eight Circuit Diagrams of the Lepel Patent

If the constants of the circuit are properly chosen, according to the theory which is explained in detail in the patent, the combination of the quenching spark-gaps with the "inertia coils" will result in an arcless discharge in the oscillation circuit, and the production of practically perfect sustained oscillations in the antenna circuit. When it is desired to telegraph by radio according to the tone method, an auxiliary tuned low-frequency circuit 15 is inserted as shown, its natural frequency being that of the note which it is desired to produce at the receiver. The effect of this added circuit is to reduce the amount of outgoing radiation periodically.

By combining several values of inductance and capacity in the tone-controlling circuit, and connecting them with a group of keys, it has been .found possible to produce tones of the musical scale and to transmit musical airs by wireless over a long distance .

Making an Induction Coil

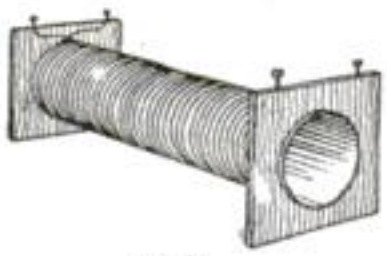


Fig I

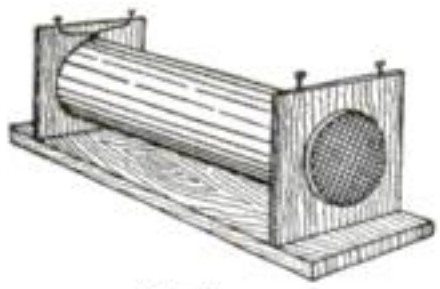


Fig II

Induction Coil Large Enough for a Small Wireless

THE laboratory of the electrical experimenter is incomplete without an induction coil, and in commercial work this device probably serves more purposes than any other piece of electrical apparatus. A coil large enough for a small wireless, and one which will make a spark big enough to ignite gunpowder some distance from the switch, can be made by any amateur, with little expense.

Secure a tube of cardboard or hard rubber, 1 ft. long, with an outside diameter of 1 in. Cut two pine blocks 1 in. thick and 6 ins. square. Bore a 1 in. hole in the end of each block and slip the ends of the tube into these holes, tacking it to the wood from the inside. Apply several coats of shellac to the whole arrangement, allowing each coat to dry before adding the next. Binding posts or wooden screws are screwed into the upper edges of the blocks, as shown in the diagram.

The coil should next be wound. If a lathe is available, fasten the tube and blocks between centers, and the winding will be an easy matter; if not, it may be wound by hand, though the process is slow. For the primary coil use No. 20 double cotton-covered copper wire. Fasten one end to a binding post, and wind a layer evenly on the tube. Coat with shellac; add a layer of thin paper and shellac that. Repeat this process until four layers are wound, fastening the end of wire to the other binding post on the same block with the end started with. Wind on several layers of paper and coat liberally with shellac. This keeps out moisture, which is fatal to the proper working of the coil.

Wind the secondary coil with about 2 lbs. of No. 36 insulated copper wire. Proceed as with the primary coil, but use the binding posts at the opposite end of the tube. Shellac and paper are applied as before; after the last layer of wire, add an extra coating of each.

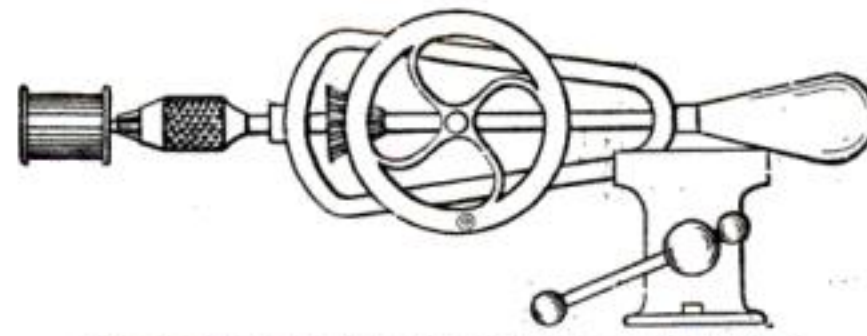
The coil may be mounted on a wooden base, 14 ins. by 6 ins. by 1 in. Give it several coats of shellac. Kiln-dried wood is best for the whole apparatus, if obtainable.—P. J. McCLUTE.

Magnet Winder

IN winding a magnet coil it is often a tedious job to get the layers smooth, especially if the wire is small. In the accompanying sketch is shown a device which overcomes this difficulty.

It consists of an ordinary hand-drill which is firmly held in the bench-vise.

The magnet spool is easily fastened in the chuck by using a long screw of the same thread as that intended for the magnet. By cutting off the head it may be held in the chuck as a regular magnet winder.—E. C. MEILLORET.



Device for Facilitating the Smooth Winding of a Magnet Coil of Fine Wire

Utilizing Broken Marble Pieces

PIECES of broken marble can often be purchased from the second-hand stores for a few cents and then cut and worked into excellent bases for supporting wireless instruments. If such bases were purchased from the marble worker they would cost a great deal more.

The pieces of marble may be sawed to shape by hand, using a strip of sheet-iron as a saw and common river sand as the abrasive. To polish the edges use sand and water upon a piece of scrap marble or glass, and rub the piece to be polished over the abrasive until the desired finish is produced.

Dry Cells and Their Voltage

THE ordinary dry cell should show a voltage of nearly one and a half and an instantaneous test-current of over fifteen amperes, if it is to be depended upon for running an induction coil or similar instrument.

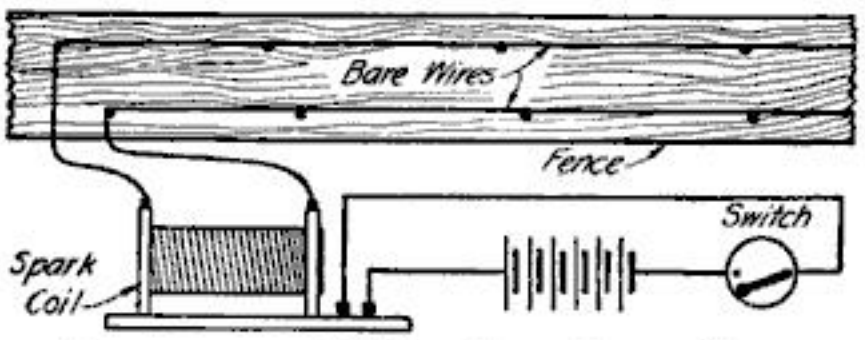
How to Rid Your Yard of Cats

CONSIDERABLE amusement may be derived from a device which effectually rids any backyard of stray cats.

There are many who may find it to be somewhat of a comfort as well as an amusement, if the number of these feline nocturnal musicians in the neighborhood is larger than is appreciated.

Nail two copper wires along the top of the fence, 1 in. apart, care being taken that they do not touch. Fasten them to insulated wires leading to the secondary of a spark-coil in the house. Connect the coil in series with six or more batteries and a switch.

When the cats appear on the fence, close the switch. The effect of the shock varies with the nature of the cat,



Arrangement of Wires Along Fence Showing One Battery and Switch

but in every case the cat will move on. A similar arrangement can be attached to a garbage can, which must stand on a dry board. The wire leading to the can is insulated, and the other should be grounded.—ALEXANDER BOLLERER.

To Stop the Milk Thief

NO one need be deprived of cream for his coffee by some hungry dividual who steals his milk bottle from the porch. The device shown here will effectively prevent any such occurrence.

The apparatus is connected with a switch, bell and battery, and when any one attempts to lift the milk bottle, the bell is rung.

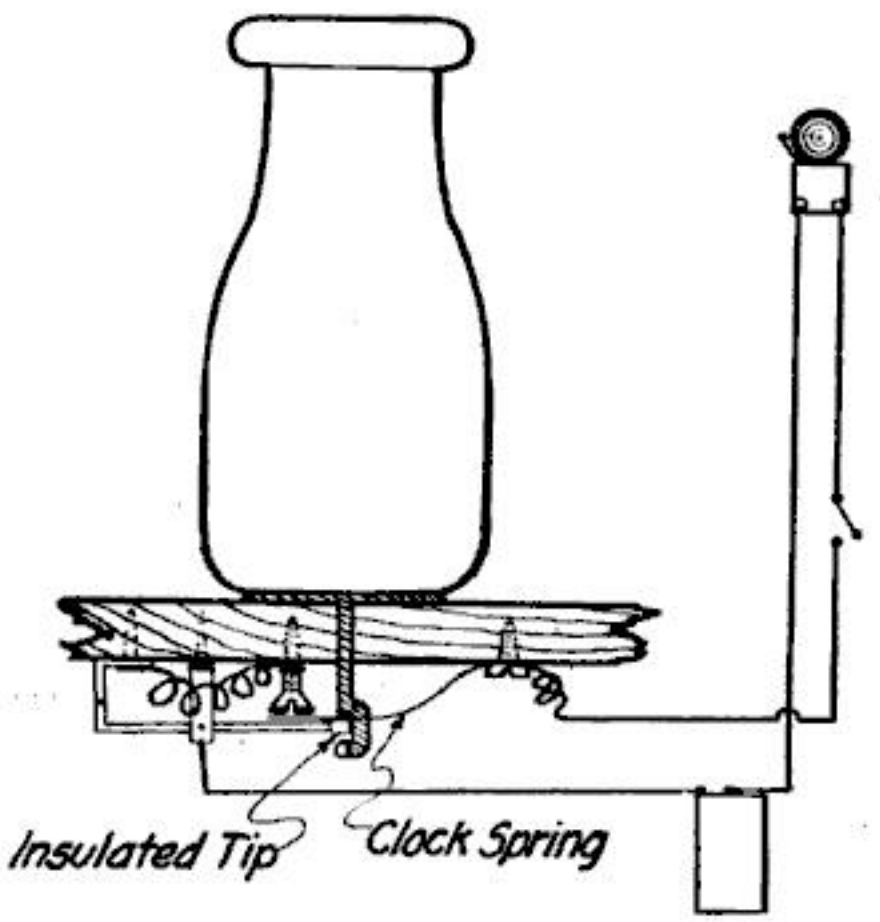
The bottle stands upon a metal disk to the center of which is joined a heavy wire, which runs through the flooring where it terminates in a loop. Through this loop runs a flat spring, which is held away from a large screw by the weight of the bottle. When the bottle is lifted the spring raises the disk and touches the large screw, forming a contact and giving the alarm.

By studying the diagram it will be noticed that one wire is soldered to a support on which is hinged a small rod insulated on one end and contacting with a small L-shaped bar, through which the current runs to the large screw. This part of the apparatus is an automatic switch.

When it is desired to set the switch, the disk on which the bottle should stand is pulled up, and the lower end of the wire loop bears against the small rod which breaks the circuit. The switch is turned on in the house. When the bottle is set upon the disk the contact is broken at the large screw, and the small rod is forced into its original position by making a contact with the L-shaped bar.

If the bottle is removed before the house switch is opened, the spring rises with the disk and makes a contact, but owing to the play in the loop, does not break the circuit through the rod. The circuit can only be broken by pulling the disk up farther than the spring can force it.

With this arrangement, it is absolutely impossible for any one to steal the bottle without your knowledge. Of course, the milkman must be instructed to be sure to set the bottle upon the disk each day.—ED. GETTINS.

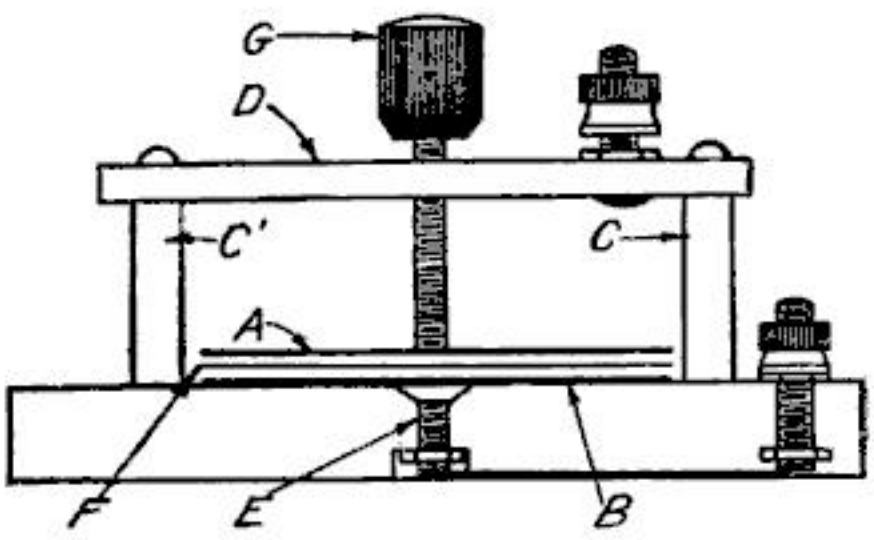


Mechanism of the Automatic Switch for Catching the Milk Thief

A New Variable Condenser

MOST experimenters find difficulty in constructing variable condensers such as sold on the market, in which the effective area of the plates varies. In the condenser here described, the distance between the plates is varied.

The instrument is mounted on a circular base 5½ ins. in diameter; *A* and *B* are brass disks 2½ ins. in diameter; *B* is soldered to screw *E* and fastened to the base as in the drawing. A wire from *E* connects *B* with a binding-post; *C* and *C*¹ are rubber pillars upon which the brass rod *D* is mounted. The rod is threaded so that *A* will remain parallel to *B*. Between the two disks, insert a sheet of mica *F*, about .005 of an in. in thickness. The capacity is varied by turning the knob *G*. The maximum capacity will be .00176 mfds. with the best grade of mica.—MATT JAROSZ.



The Distance Between the Plates in This Condenser is Variable

The Quenched Gap

AMONG other things the close coupling, and consequently the increased efficiency of radiation, possible with this type of gap, make its use very desirable. Unfortunately it does not prove very satisfactory for amateur use, as the 60-cycle current usually supplied on lighting circuits to which amateurs have access, used with ordinary transformers, often gives a very mushy note to the spark. This renders it unsuitable for working through static or other interference. The difficulty may be avoided to some extent by using the quenched gap in series with a rotary gap, thus raising and regulating the frequency of the discharges. The quenched gap can also be used with a spark-coil, but the resulting note is not always very satisfactory.

With regard to the adjustment of the gap, it should be noted that the plates must be kept clean and air-tight.

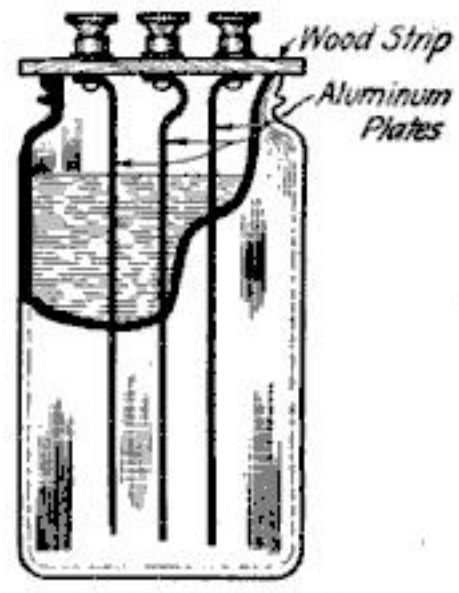
A Kickback Preventer

THE apparatus described herein is one of the simplest forms of kick-back preventer, and will take care of all high frequency surges on the primary leads of a wireless transformer.

It consists of three plates of aluminum, immersed in a saturated solution of sodium phosphate or bi-carbonate of soda.

In the drawing is shown a method for suspending the plates in a common quart mason-jar. The instrument is to be connected to the apparatus as shown in the wiring diagram.

Its action is not unlike that of a condenser, due to the thin insulating film that forms on the plates when current tries to pass from one plate to the other. Any extremely high voltage surges will puncture this film and thus be discharged to earth. The fuses will prevent the flow of too much live current. The film is replaced automatically when the voltage is reduced. It may be noted that two small aluminum plates immersed in the above solution placed in a test tube, will form a good renewing condenser of fairly high capacity.—ROBERT KENNEDY.



Method of Suspending the Plates in a Quart Mason Jar

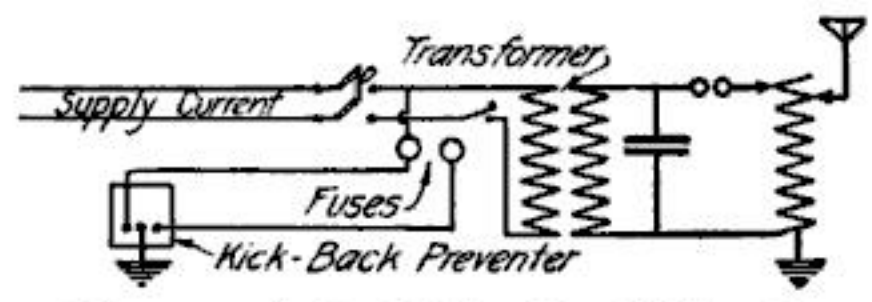


Diagram of the Wiring by Which the Instruments are Connected

How to Become a Wireless Operator

I.—Why Wireless is Interesting

By T. M. Lewis

NOBODY knows just how many amateur wireless operators and experimenters there are in the United States; the total number has been estimated as somewhere between twenty thousand and fifty thousand. Nearly ten thousand licenses for amateur stations have been issued by the Department of Commerce. Each one of these licenses is for an amateur station which contains both a transmitter and a receiver. No license is required for stations equipped for receiving only, and it is believed that there are many more of these than of the sending stations.

Why have so many American boys and young men taken up this subject? What is there about it that interests them, and induces them to spend their time and money in buying, building and using wireless instruments? The answer to these questions is simply that wireless or radio telegraphy represents one of the latest developments of electrical science, and that it offers both amusement and profit to whoever cares to work upon its problems.

Whether you wish merely to make a pastime of wireless experimenting or desire to study radio telegraphy with the intention of making some part of it your profession, you will find time spent on it well worth your efforts. In the first instance you will be able to receive messages through the ether from stations many miles away, getting press reports of important news items, and the results of races and ball games and so forth, before they are published in local papers. In the second case, you will be able to train yourself as a radio operator or installation engineer, or possibly you will make new inventions or discoveries of commercial value. Either way you will constantly be learning more and more about electricity and its applications, as well as getting a better knowledge of many important physical principles which may be used in almost any kind of work.

In addition to all this, there lies before you the fascination of sitting at your receiving instruments and listening to wireless messages from stations located all about you. Soon after you begin it is possible to hear from distances of several hundred miles, and after you have gained a thorough knowledge of your instruments and their possibilities it becomes feasible to listen to the tremendously powerful transmitters even so far away as Germany and the Hawaiian Islands.

Elementary Principles

This article is the first of a series which will describe a number of really practical and useful instruments for use in radio telegraphy, both for sending and for receiving. The ways to make and use these various pieces of apparatus will be discussed in detail, but it is not proposed to go into the theory of wireless telegraphy at all. By going to your library you will be able to find books and periodicals which describe the principles of etherwaves and their uses in wireless; some of the books you will wish to buy and have in your own workshop for ready reference. Among the most interesting

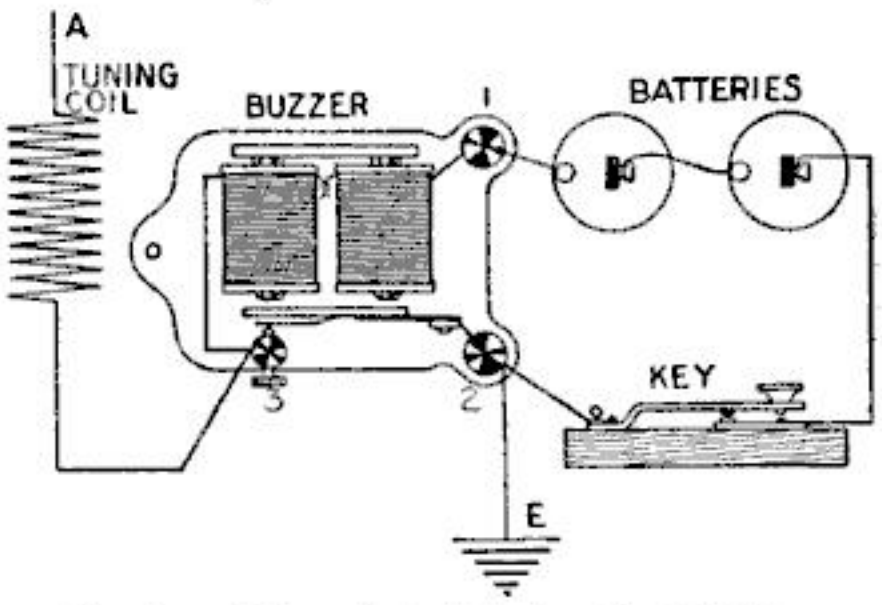


Fig. 1. A Complete Wireless Set Which Is Capable of Sending Messages

and valuable of these are the following, which are named in the approximate order of their complexity:

"The Elementary Principles of Wireless Telegraphy," by R. D. Bangay.

"Experimental Wireless Stations," by P. E. Edelman.

"Wireless Telegraphy," by A. B. Rolfe-Martin.

"Textbook on Wireless Telegraphy," by Rupert Stanley.

"Wireless Telegraphy," by W. H. Marchant.

"Elementary Manual of Radio Telegraphy," by J. A. Fleming.

"A Handbook of Wireless Telegraphy," by J. Erskine-Murray.

"Wireless Telegraphy," by J. Zenneck, translated by A. E. Seelig.

The above list should be useful as a guide in hunting for technical information about radio telegraphy. There are many other books on the subject, a large number of which are excellent. Those named, however, include one or more of each type from the most elementary to the most advanced.

A Simple Transmitter

In beginning experiments on wireless telegraphy it is best to take up first the least complicated arrangements, which are suitable for very short distances, and then to work along gradually from these to the more important instruments. This first article, therefore, will describe the use of a complete wireless set which is capable of demonstrating the principles involved. By its use you should be able to send messages a distance of a few hundred feet, from one part of the house to another; by using long aerial or antenna wires, upward of a quarter of a mile may be covered.

The sending station involves nothing more than a simple buzzer, a telegraph key, a tuning coil and a few cells of dry battery. These are to be connected together as shown in Fig. 1; a good kind of wire to use is No. 18 annunciator, since this has a strong waxed double cotton covering which is easily removed. The buzzer can best be purchased from any electrical supply store for about forty cents; the key may be bought, or simply improvised by cutting and bending some thin strips of brass as shown in Fig. 2; the dry cells will cost from twenty to thirty cents each.

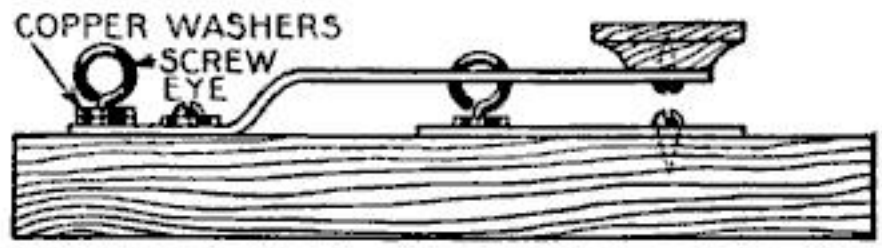
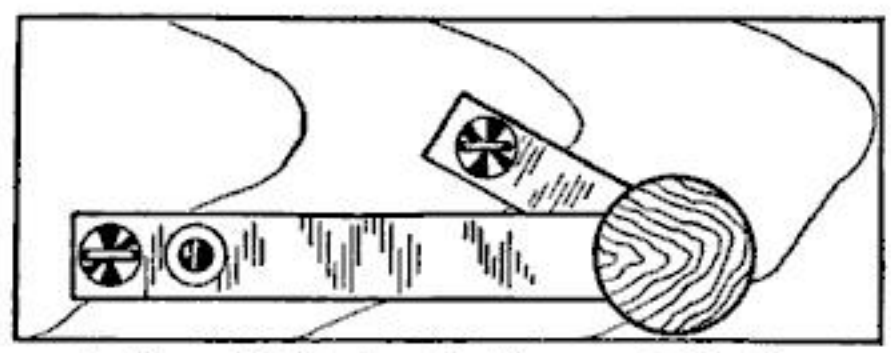


Fig. 2. The Construction of the Buzzer for Sending Apparatus



A Key Made by Cutting and Beading Some Thin Strips of Brass

The tuning coil may easily be built by winding about fifty turns of annunciator wire on a cardboard tube approximately three inches in diameter. The ends may be fastened and at the same time made available for convenient connection by attaching them to binding posts let into the tube at the top and bottom. There is no need of building this tuning coil of any specific size. The diameter may be anything from two to four inches, and the number of turns from thirty to seventy. It is only necessary that two identical coils be built, one for the sender of Fig. 1, and the other for the receiver of Fig. 4.

In setting up the sender it will be found that one end of the tuning coil must be attached to the contact post of the buzzer, which is marked 3 in Fig. 1; this can be done by removing the cover of the buzzer and wrapping a bare copper wire firmly about the post. Care must be used to prevent the contact wire from touching the metal base, however, or the operation of the buzzer will be stopped. Binding post 2 is to be connected with "earth" as indicated at *E* in the diagram. The earth connection is easily made by running a wire to a water pipe or steam radiator and wrapping the bare end tightly about a scraped or plated portion of the pipe. The upper end of the tuning coil is to be led to the aerial or antenna wire, at *A*. This antenna may be of any convenient size,

but the larger it is the farther you will be able to signal. For transmitting from room to room within the house, it will be sufficient to string some twenty feet of wire around the picture moulding near the ceiling.

If you have set up the apparatus properly the buzzer will hum strongly as long as you hold down the sending key and thus close the battery circuit. By pressing the key for short and long intervals you can produce short and long buzzes which correspond to dots and dashes in the Morse telegraph code; in this way messages can be spelled out letter by letter.

A Microphone Receiver

For the receiving station you will need to make another ground connection by fastening a wire to the steam or water pipes, and then the next thing is to build a second antenna or aerial wire system exactly like that at the sender. The second tuning coil, an old dry cell (preferably one which has become very weak), a telephone receiver and the microphone detector are to be connected together as shown in Fig. 4. Any telephone receiver will do; you can buy a 70-ohm watchcase instrument from an electrical store for about 75 cents, but if you intend to continue with wireless experimenting it will pay you to invest several dollars in a pair of telephones of high sensitiveness. These will not only make it possible to receive messages from longer distances, but because of the headband with which they are fitted you will be relieved of the nuisance of holding the receiver to your ear and will have both hands free for manipulation of your apparatus.

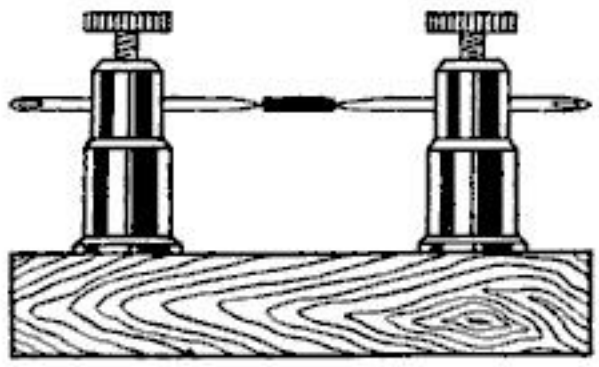


Fig. 3. How the Microphone Detector is to be Made

The microphone detector is to be made as shown in Fig. 3, which indicates how two large double binding posts are to be mounted upon a hard rubber or wooden base. Two sharp sewing needles are inserted into the upper holes of the binding posts, and between their points is lightly supported a short length of graphite from a soft pencil. The piece of graphite should be about one-half inch long, and should have its ends partially hollowed out so that it will hang easily upon the needle points. It is not to be clamped firmly, but allowed to rest so loosely that it may be revolved freely and even slid a very short distance back and forth.

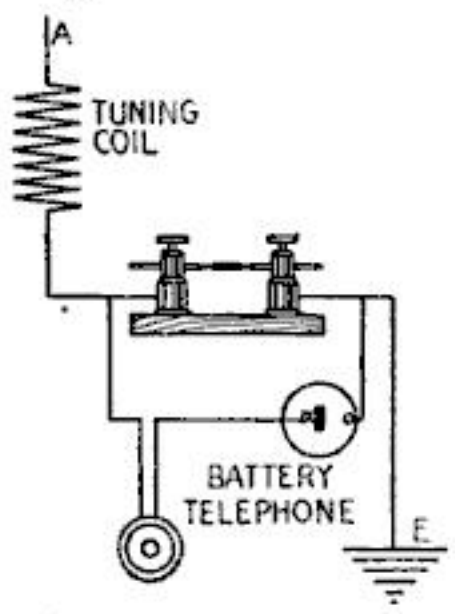


Fig. 4. How the Telephone Receiver and Microphone are to be Connected Together

Operation of the Apparatus

After you have set up both stations according to the diagrams, have someone work the transmitter key, making regular test signals such as "V" or "D", and go to the receiver. Listen carefully to the telephone receiver, and move the graphite piece of the microphone around slightly. You will notice that you can hear every touch; when the microphone is adjusted to its most sensitive condition there will be a continuous slight hiss in the telephone receiver, and even the slightest taps on the table or instrument base will be clearly heard. When the apparatus is adjusted in this way you should hear the buzzes of the transmitter reproduced in your telephone, and so should be able to copy the signals sent out from the transmitting station.

If you have any difficulty in getting good results, try again with the receiver nearer to the sending station. When you have once transmitted good signals, move the stations farther apart. Remember that it is necessary to have good ground connections, that the two tuning coils must be exactly alike, and that the sending and receiving antennas must be identical. If you are able to erect fairly large aerials for the two stations, such as, for instance, sixty foot lengths of wire supported by trees or poles, you should be able to transmit signals a

distance of five hundred or a thousand feet; with larger aerials even greater distances can be covered. Begin in a small way, however, and make your progress a step at a time.

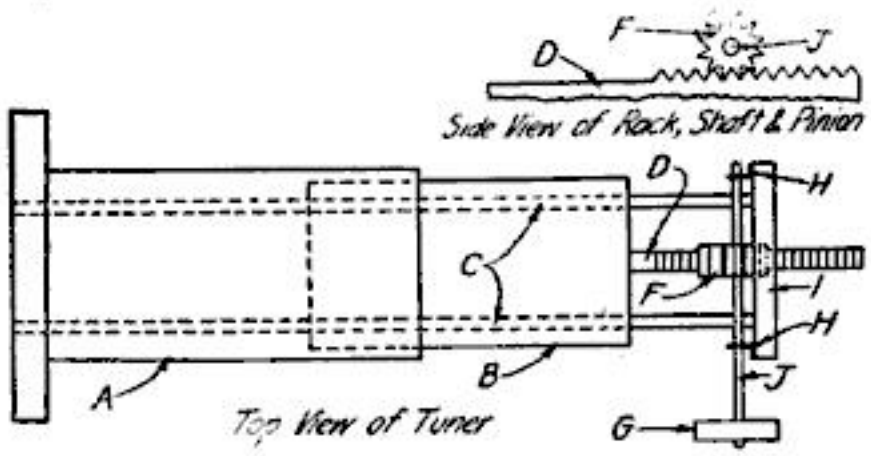
If you are near a commercial or Naval wireless station you will be able to receive signals from it by using the apparatus of Fig. 4; better arrangements which will operate over longer distances will be explained in later articles, however. The microphonic detector of Fig. 3 is quite useful when connected to a commercial wireless tuner, and knowing how easily it may be built from material commonly at hand may be of value even to the commercial wireless operator, in times of emergency.

You will find it important to become a good telegraph operator if you propose to continue wireless experimenting. There are a number of pamphlets and books published which explain methods of learning the Morse code; Chapter IV of "The Book of Wireless," by A. Frederick Collins, gives a good method to follow. Cards showing the International Morse Code in full may be obtained from the Radio Inspectors' offices at Boston, New York, Baltimore, Savannah, New Orleans, San Francisco, Cleveland and Chicago. It is only by constant practice that you can become proficient.

(To be continued)

A Rotary Adjustment for Coupling

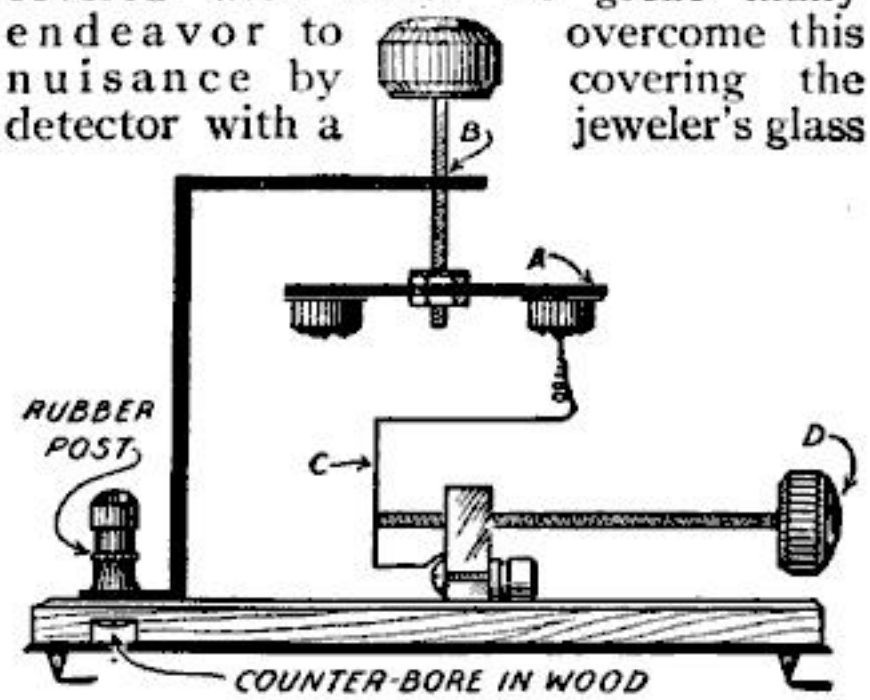
A SIMPLE method of building a rotary adjustment for coupling of receivers is shown in the drawing, where *A* is the primary coil, *B* the secondary coil, and *C* indicates the slide rods for the secondary. At *D* is shown a small square brass rack which meshes with a small pinion about ½ in. in diameter at *F*. The pinion is carried on shaft *J*, which is supported in small angles made of 1/16 in. sheet brass, as shown at *H*. A hard rubber or fiber knob is shown at *G*. The rack *D* may also be attached to the secondary coil with a small angle of 1/16-in. brass. A hole should be bored through the end-piece *I* to permit *D* to slide through. The brass rack and pinion may be purchased from any dealers in model supplies. The arrangement will be found well worth the trouble of making, since a very fine adjustment of coupling may be invariably obtained.—C. H. RAUSCHENBERG.



Arrangement of Coils in Rotary Adjustment for the Coupling Receivers

A Curious Form of Dustproof Detector Cup

IT is well known that detectors of the mineral type rapidly depreciate in sensitiveness when the minerals become covered with dust. A great many endeavor to overcome this nuisance by covering the detector with a jeweler's glass bell or by other means. A new scheme is shown in the drawing. The mineral cups are placed on a brass bar or disk, *A*, supported by an adjustable threaded rod *B*.



Scheme to Protect Detectors of the Mineral Type from Dust

A fine "cat-whisker" wire contact point of the usual type may be placed on a brass spring *C*, which has its tension adjustable by means of a threaded rod and knob *D*. At first this may seem a little inconvenient, but it really is just as easy to adjust as if the mineral cups were facing upward, as in most detectors. This is because the sensitive spots on the mineral are found by feeling around with "cat-whisker" contact.

What Radio Readers Want to Know

Announcement

Beginning with this issue, the Editors are extending the scope of the Questions and Answers Department so as to include a Radio Readers' Service Bureau. Answers to any questions you wish to ask us will be sent by mail directly to you. Queries of general interest, with their answers, will be published monthly in these pages.

This new service is furnished free to our readers. The questions will be answered by authorities in the branches concerned. Your inquiries may be on any topic related to wireless telegraphy or telephony.

The Editors suggest, however, that queries as to the wave-lengths of aerials and the working distance ranges of various senders and receivers be withheld. These subjects have been explained so often that almost any desired information as to them may be found by reading over the earlier issues of the magazine.

What books to read, how to build apparatus, how to adjust it, and where to buy it, are only a few of the things we can tell you. If we can help you, write to us!

A Simple Wireless Telephone

L. N. P., Waynesville, O., writes:

Q. 1. Please state where I can obtain directions to make a simple wireless telephone set that will transmit to a distance of one or two miles. I desire an apparatus that does not include an arc gap or other expensive apparatus. Please give instructions for the construction of a simple set.

A. 1. You are advised to purchase a copy of "Simple Wireless Telephones and How to Make Them," on sale by the Book Department of this magazine. The price is 25c per copy.

A very simple wireless telephone set for amateur purposes may be constructed in the following manner: If you are already in possession of a wireless telegraph transmitting set, you can take the high potential transformer and connect it directly to the terminals or the spark gap, the latter in turn being connected in series with the antenna system. A microphone transmitter is connected in series with the earth lead for variation of the antenna current in accordance with the vibrations of the human voice. Due to the small capacity of the antenna the spark assumes the nature of an arc, and oscillations of an exceedingly high spark frequency flow in the antenna circuit. In fact they are of sufficient frequency to permit the transmission of the human voice. You should have no difficulty in covering a distance of one or two miles with this apparatus.

Receiving Long Waves

M. M., Danville, Pa., inquires:

Q. 1. What is the wave length of my aerial which is 140 feet in length, 35 feet in height, consisting of two copper wires on four foot spreaders. The lead-in wires are 25 feet in length.

A. 1. The fundamental wave length is approximately 310 meters.

Q. 2. Please give the size and dimensions of a long wave length loose coupler to be used with this aerial.

A. 2. The longest wave length used by any spark station is that of the Marconi Company at Glace Bay, which employs a frequency wave length of 8,125 meters. In the November, 1915, issue and the April, 1916, issue of this magazine, there are described the complete circuits for an oscillating audion detector which will permit loud response from stations using damped and undamped oscillations, and you would secure better results by constructing apparatus of this type rather than a simple inductively coupled receiving tuner. However for crystalline detectors the tuner may have the following dimensions: The secondary winding 6″ in diameter, 12″ in length, wound with No. 30 S. S. C. wire. It is intended to be shunted by a condenser of .0005 microfarads. The corresponding primary winding is 7″ in diameter, 12″ in length, wound closely with No. 24 S. S. C. wire. The loading coil for the antenna circuit is 14″ in length, 7″ in diameter, wound with No. 22 S. S. C. wire.

Sending on Short Wave

W. D. H., Olathe, Kansas, writes:

Q. 1. I have an aerial 50 feet in height, 200 feet in length, composed of a single wire. The lead-in is 35 feet in length and the ground lead 20 feet. Please advise how to construct a short wave condenser that will reduce the sending wave length to 200 meters. I use a ½ K. W. high potential transformer.

A. 1. The fundamental wave length of your aerial is approximately 360 meters which is rather long to be operated at wave lengths of 200 meters. In fact a series condenser will just barely reduce the natural wave length to 200 meters and will not allow turns to be placed in the secondary winding of the oscillation transformer. You are advised to reduce the length of the aerial to 130 feet and then if possible attach the lead-in wire to the center of the flat top portion. With this connection you can send at the wave length of 200 meters without a series condenser.

Receiving Long Waves

F. F. L., New Rochelle, N. Y., writes:

Q. 1. I have an aerial of the inverted "L" type, consisting of four wires spaced 2½ feet apart. It is 58 feet in length, 50 feet in height at one end and 35 feet at the lower end. The lead-in is attached to the lower end and is 12 feet in length. The ground wire is 40 feet in length. The primary winding of the receiving transformer is wound with 255 turns of No. 24 S.S.C. wire on a cardboard tube 3⅞" in diameter. The secondary winding is made on a tube 3¼" in diameter for a length of 5⅞" with No. 30 S.S.C. wire. There are eleven taps on the primary winding. I use an Audion detector. Can you compute the wave length of the aerial and the possible adjustment with the receiving tuner described?

A. 1. The natural wave length of the aerial system is approximately 190 meters, and with the primary winding connected in series is adjustable to 1900 meters. The secondary winding with a capacity of .0001 microfarads in shunt will respond to 1600 meters and to about 3,000 meters with .0005 microfarads in shunt.

Q. 2. Can this antenna be loaded by means of inductance coils to receive Nauen, Germany, and allow the reception of their signals day and night with a sensitive oscillating audion? It is impossible to erect another aerial.

A. 2. It would be possible to load this aerial so as to secure response from Nauen, Germany, but the present receiving tuner will not afford sufficient closeness of coupling for the best response. You should construct apparatus like that described by A. J. Watts in the November, 1915, issue of the POPULAR SCIENCE MONTHLY. Also see the article by McKnight in the April, 1916, issue.

Q. 3. When using 101 turns of the primary winding, and five sections of the secondary winding, with a correspondingly low degree of coupling, I obtained signals from the Brooklyn Navy Yard loud enough to be heard over two floors. When the entire primary and secondary windings are in use with a close degree of coupling, I get Arlington signals loud enough to hear them 20 feet from the head telephones. I also receive Brooklyn Navy Yard at this point just as loud as at the first mentioned adjustment completely drowning out Arlington. A change in the coupling or an alteration in the capacity of the variable condenser has the effect of weakening the signals from Arlington without a decrease in the strength of the signals received from the Navy Yard.

I experienced similar results with New York Herald and the Cape Cod, Mass., stations. Previous to this I owned a transformer with which I could cut out the New York Herald and still receive Cape Cod, but did not get any stations as loud as those I can tune to with the present coupler. I also hear signals with this coupler that before could not be heard. I have tested the windings carefully for short circuits; do you think the phenomenon I have described is due to faulty construction or what is the cause of it?

A. 3. You will readily understand from the data we have given you that your receiving tuner cannot be placed in resonance with Arlington, although with a close degree of coupling you are able to hear these signals on account of forced oscillations. You should also understand that when a close degree of coupling is used between the primary and the secondary winding of a receiving tuner that the receiving circuits are broadly tuned and simultaneously responsive to a number of wave lengths. To place your apparatus in complete resonance with Arlington you require larger primary and secondary windings, or a load coil and larger secondary condenser.

Q. 4. Are the results obtained just as satisfactory when the primary winding is tapped every twenty turns and the variometer connected in series with the antenna circuit as with the ordinary method where two switches are employed for the purpose?

A. 4. Yes, it is somewhat better to use the variometer, as a rule.

The Construction of Variometer Windings in Single Layers and in Multi-Layers

M. A., New York, N. Y., inquires:

Q. 1. In the construction of variometer coils, should they be wound in single layers or in multi-layers?

A. 1. If the coils are narrow and consist of but a few turns, it is practical to use a multi-layered winding, but if the variometer is to consist of a great number of turns of wire, multi-layered winding should be avoided.

Requirements of Fire Underwriters Concerning Radio Installations

G. S., Richmond Hill, N. Y., inquires:

Q. 1. I am somewhat confused on the requirements of the Fire Underwriters in respect to radio installations. What are the dimensions of the lightning switch and the size for the corresponding earth wire? Can copper clad iron wire be used in place of copper wire?

A. 1. The lightning switch must have a current carrying capacity of 100 amperes and the ground wire must be at least a No. 4 copper wire. Iron wire of any description will not be passed.

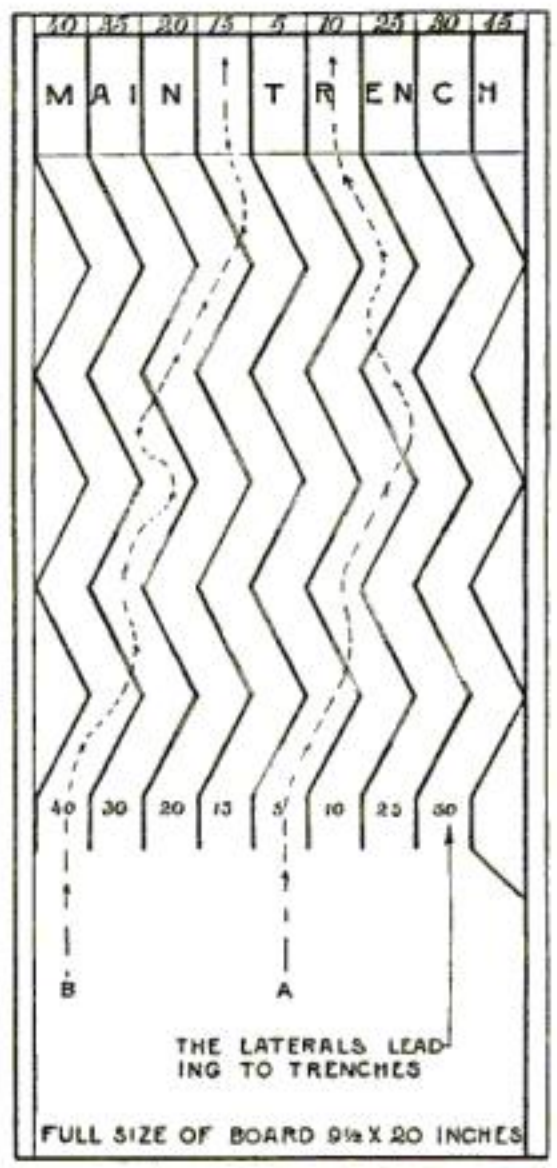
The Trench Marble Game and How It is Played.

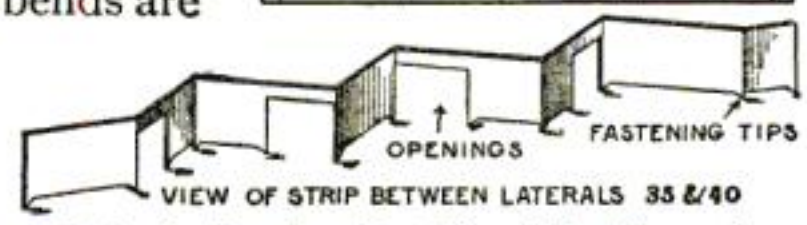
AN exceedingly interesting marble game can be played by using the trench system of laterals.

The device is mounted on a board 9″ x 20″, preferably of soft pine, an inch thick. This has strips on one end and along the two sides which project an inch above the surface of the board. Between these strips are nine zig-zag walls, each an inch in width, or in height, which are arranged ¾″ apart.

The detail drawing shows one of these strips in perspective. Each section, between the bends, is 1½″ in length, except the first section, which is ¾″. The chance element of the game is provided for by forming openings, at odd intervals, through the zig-zag walls. No two strips are alike in this particular.

Use heavy block tin, or No. 18 gage galvanized iron. After cutting each strip 1⅛″ wide and 11¼″ long, make the seven cross marks where the bends are to be, as shown, and then cut out openings at the places indicated. Then, at each corner, cut a triangular tip, or point, as shown.





Strip Indicating Details of the Second Wall on the Playing Board

Lay out the board, showing where each wall is to be placed, and with a hammer drive the tips into the board, after the wall is put in position. In this manner eight lateral trenches are formed which lead to the main trench at the opposite end of the board.

The knuckles of the hand must not pass beyond the end on the board in shooting. The player may select any lateral in shooting, the object being to win the highest number. The device not only cultivates accuracy in shooting, but develops the element of speed.

When a marble is shot into a particular lateral it may or it may not follow along that course from end to end. Probably, if the marble should be allowed to roll by gravity along each lateral, it would not deviate. But the marble must be shot, and the result is that in passing the bends in the lateral it is thrown violently in the direction of the communicating trenches. For instance, player *A* made his shot into the lateral 5; at the second bend it was diverted to trench 10, and a little further on to lateral 25, only to be thrown back again into 10. The player *B* started in lateral 40, but the marble ended in the main trench at 15.

Iceless Cooker and Refrigerator

DEPENDING upon the heat of the sun to reduce the temperature within a cooler or refrigerator may seem anomalous, but it has been proven scientifically to be possible. The warm summer days bring into prominence the important question of preserving food and keeping on hand a supply of cool water. This is an easy matter where ice and the receptacles for holding it are available; but it is very desirable to provide a means whereby a safe and positive method of cooling can be depended upon, without relying too much on the care which must be given to the use of ice. The illustration shows the application of the principle to a water cooler, Fig. 1; and also structurally arranged for a refrigerator, Fig. 2, or receptacle for holding food.

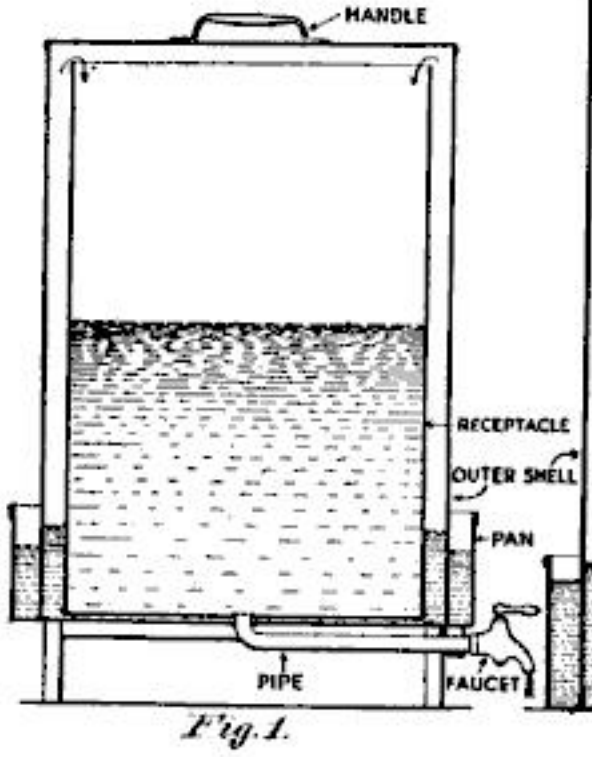


Fig. 1.

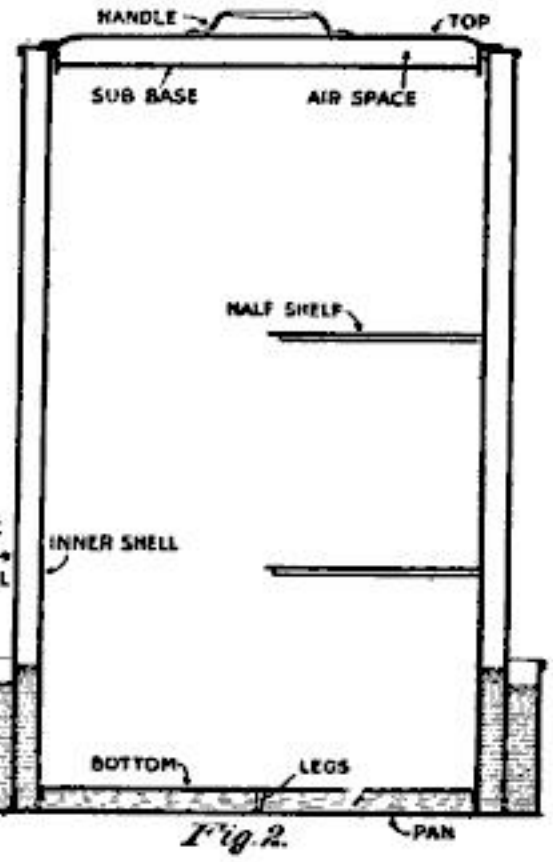


Fig. 2.

The Faucet Permits the Water to Be Drawn From the Shell Without Disturbing the Water in the Pan

The cooler may be made of heavy tin, galvanized iron, glass, or stoneware. For convenience the construction is of galvanized iron. It is exceedingly simple in design, and comprises a pan sixteen ins. in diameter and four ins. deep. Secured to this pan centrally is a receptacle ten ins. in diameter, and eighteen ins. high. The receptacle and pan are secured to each other by means of an L-shaped pipe, the short end of which passes through the bottom of each. With a washer between the two bottoms, the pipe is well soldered so as to make water tight joints.

The pipe extends out horizontally below the pan, and is provided with a faucet at its projecting end. A second vessel twelve ins. in diameter with a depth of twenty ins. is inverted over the inner vessel, thus providing an annular air space of one in. around the vessel designed to hold the drinking water. The outer shell has a handle so that it may be readily removed.

The refrigerator form, Fig. 2, also uses a pan twenty ins. in diameter, the sides being six ins. high. The body of the refrigerator is made of two cylindrical shells, the outer one being eighteen ins. in diameter, and the inner one, sixteen ins. Both are the same length, and two feet in height, joined together permanently at their upper ends by means of a rim. These two parts are provided with legs and the inner shell has a bottom one inch above the pan base.

It will thus be seen that water placed in the pan will flow into the space between the two shells, and also beneath the bottom. A top with a handle and a sub-base so as to provide an air space between, is adapted to fit snugly within the inner shell. One or more half-shelves may be placed within the inner shell.

In the cooler, water is also placed in the pan entirely separate from the drinking water which is in the shell.

The cooling principle may be stated as follows: The temperature of rarefied air is cooler than air at normal pressure. Condensation also plays an important part in the cooling process. The moment any water is drawn from the cooler shell the pressure of air on the surface of the

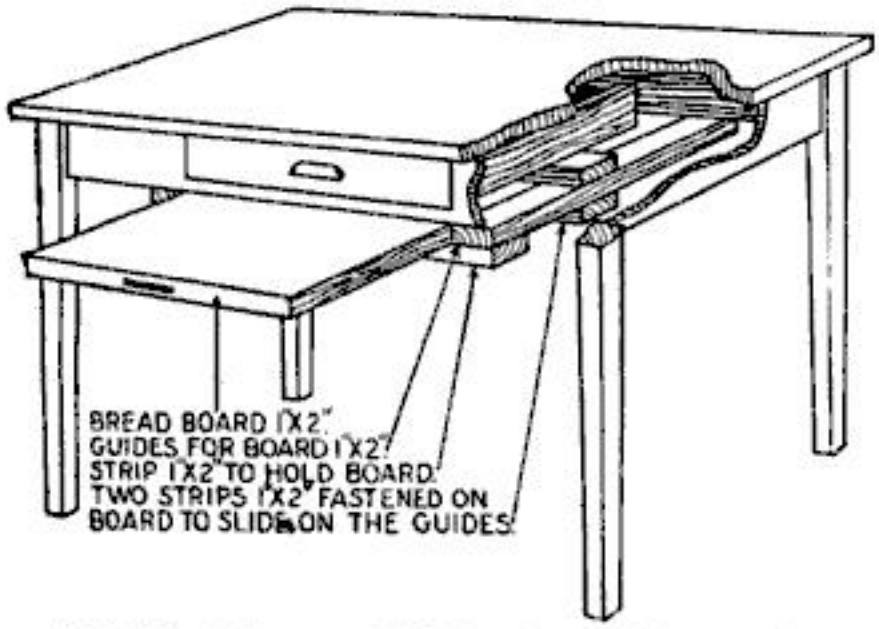
water in the pan surrounding the outer shell causes the water to flow up in the air space between the shells. The result is that the air within the water cooler is more rarefied than the air without.

At the same time, warm air on the outside of the shell, and cool air on the inside, produces condensation, which also assists in lowering the temperature within, the degree of cooling being dependent on the rarefication and amount of condensation produced. It is this principle which is employed in the Mexican Oya, or water bottle, which is made of thick porous clay which "sweats" profusely, cooling the water within.

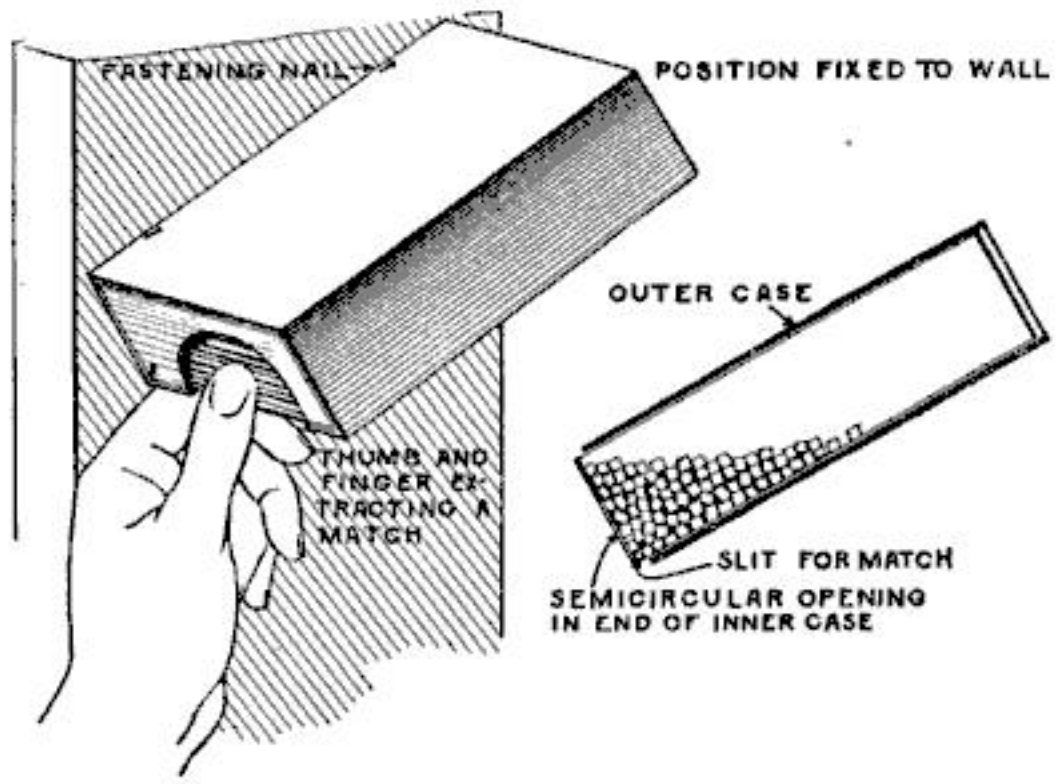
A Typewriter Desk Made from a Kitchen Table

A KITCHEN table was converted into a typewriter desk in the following manner: An 18-in. by 24-in. bread-board was purchased from the hardware store and some pieces of 1-in. by 2-in. soft wood obtained. Two pieces of the latter were placed across the under side of the table, from the back to the front boards, serving as guides for the bread-board. Two more pieces were fastened to the board near one end and arranged to fit over the side pieces.

The board was put in place as a shelf under the table and a final cross strip of the 1-in. by 2-in. board was fastened to hold the front in place and allow the board to slide under the lower edge of the front board.—E. W. HYMAN.



A Shelf of Correct Height for the Typewriter Has Been Added to the Table



In This Position the Matches Gravitate to the Lower Exposure End of the Box

A Simple and Convenient Receptacle for Matches

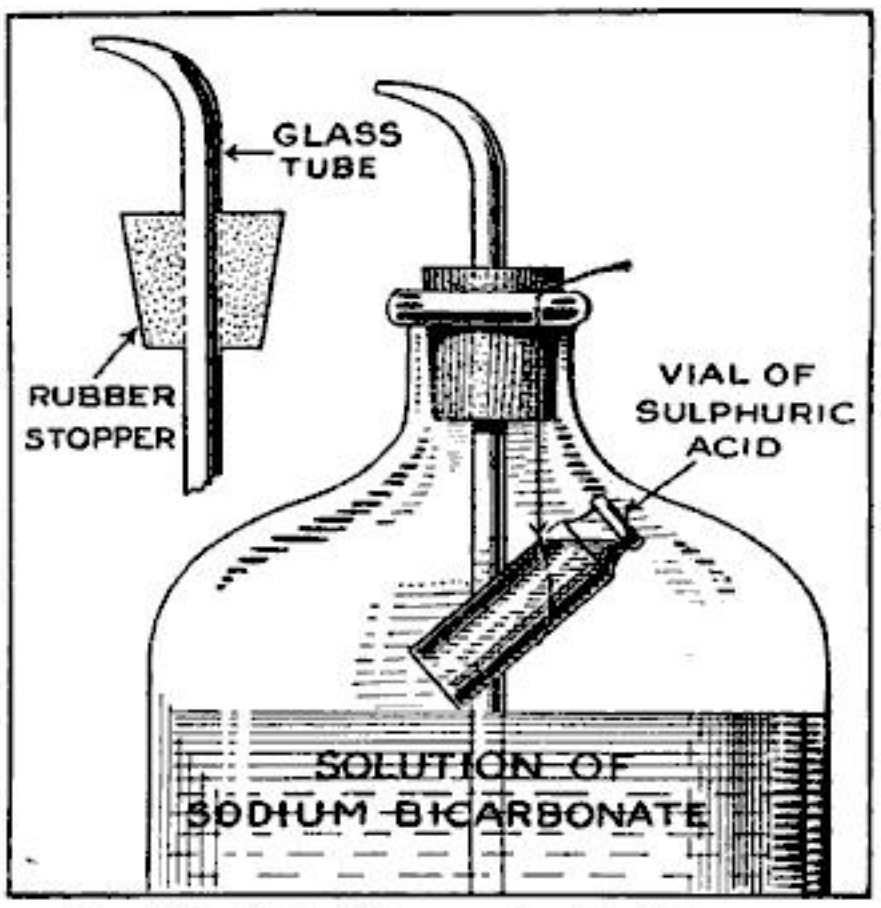
A MATCHBOX which does not have to be opened and from which only one match at a time can be extracted, is shown in detail in the accompanying illustration.

The ordinary sliding carton is a most unsatisfactory contrivance for the reason that the greatest care must be exercised in opening it and removing the retarding strip. Every time a match is required both hands are necessary to open the box and extract it.

The new box has at one end and in the bottom a cut-out portion so as to expose the matches, only the ends being supported against the uncut portions of the box. In the corners, however, the box is slit so as to provide a means for drawing out the match.

In use the box should be secured to some object on the wall or wainscot at an angle by means of small nails driven in the upper corners. In that position all the matches will gravitate to the lower exposure end of the box in position to be grasped by the thumb and forefinger.

It is not a difficult matter to convert the ordinary box into a receptacle of this kind for permanent attachment to the wall. The sectional view shows how this may be done. In order to refill it from a new box the inner sliding portion only is removed, and when filled it is returned to the stationary case which is fastened on the wall.



The Liquid is Thrown by the Pressure of Gas Generated in the Bottle

A Home-Made Fire Extinguisher

AN amateur mechanic can easily make a fire extinguisher to work upon scientific principles the same as do the ones used in large buildings. As in the larger extinguishers, the liquid is thrown by the pressure of gas generated by mixing a solution of soda (sodium bicarbonate) and sulphuric acid. The materials necessary are a bottle of about two quarts capacity, a piece of glass tubing a little longer than the height of the bottle, a rubber stopper to fit the bottle, and a small straight medicinal vial.

By the use of an alcohol lamp, one end of the glass tube is heated and brought to a point. The point is then broken off, leaving a hole in the end about one-sixteenth of an in. in diameter, and the tube is bent.

If you cannot procure a stopper with a hole in it, one must be drilled to fit the glass tubing, which should be about one-fourth in. in diameter. The next step is to push the tube through the stopper so that the end of the tube almost touches the bottom of the bottle when the stopper is in position. Tie a string around the small vial about one-half way between the middle and the open end. (See drawing.) To charge ready for use, fill the bottle with a solution of baking soda so that there is barely room enough to hang the smaller vial inside the bottle clear of the solution. Next, fill the vial almost full of sulphuric acid and carefully lower it into the bottle, placing the stopper in tightly so that the string suspending the small vial is held firmly between the stopper and the mouth of the bottle. In case of a blaze, grasp the bottle tightly in the hands, give it a few vigorous shakes to mix the two solutions and direct the stream of water (charged with carbon dioxide) on the blaze and it will be quickly extinguished.—WAIN MARTIN.

A Towel Holder

A HANDY and practical towel holder can be made by the busy housewife. Remove the fasteners from worn-out and discarded garters and also the part that is attached to the stocking. Sew a small silver or brass ring to it. Fasten a towel to it as you would a stocking and hang it on a hook or a push-pin.

This holder can be used in places where a rack or rod might possibly be in the way.—WILL CHAPEL.

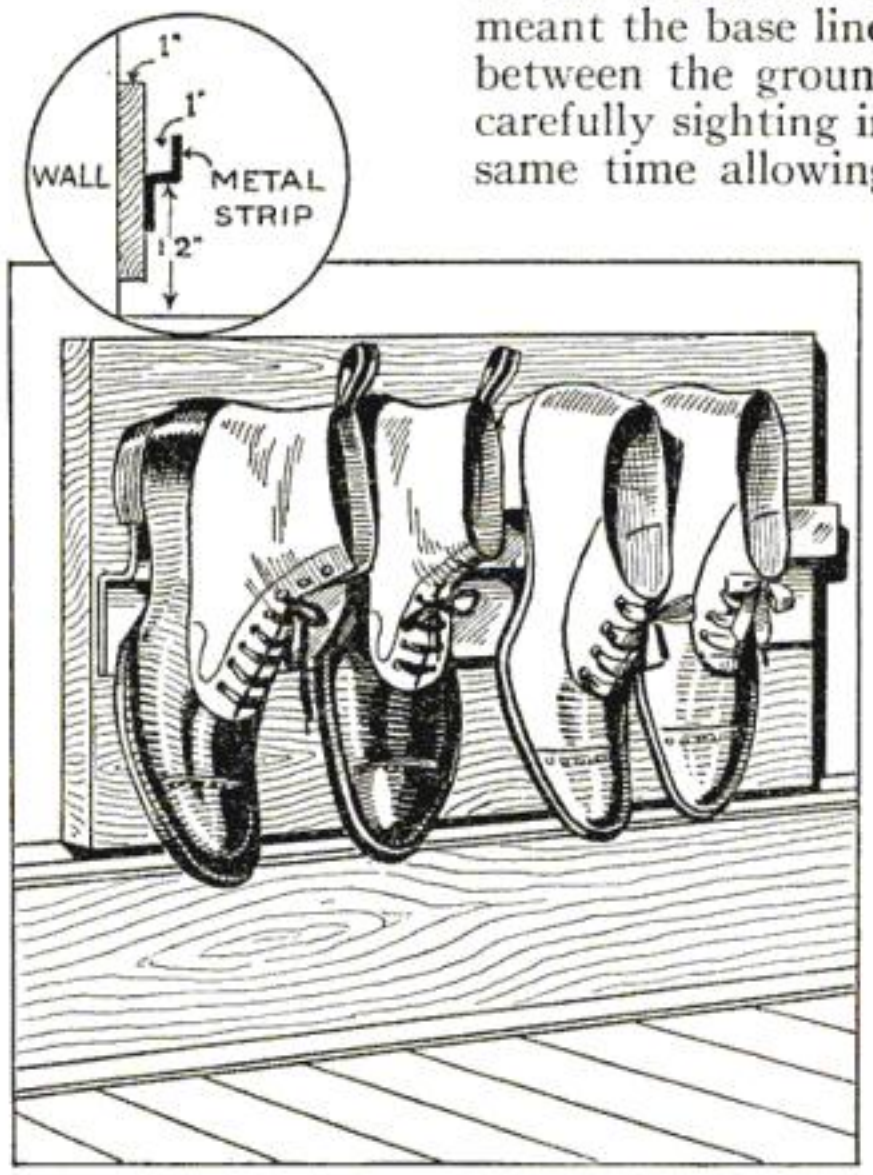
The Strap as a Jar Opener

UNSCREWING the tops of jars is a simple operation with the aid of a shawl or belt strap. The strap can not slip because the harder it is pulled the harder it grips the jar. If the main part of the jar can be held to withstand the pull of the strap the most obstinate cover will have to capitulate. Where the ordinary types of jar openers do not fit the strap is an effective substitute.

The Harder the Strap Is Pulled the More Firmly It Grips the Jar. There Is No Possibility of Slipping or Breaking, Provided the Body of the Jar is Held Securely

A Convenient Shoe-Rack

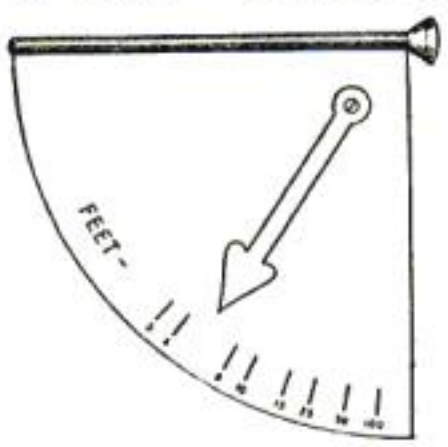
A STURDY shoe rack can be constructed as follows: Fasten a board along the wall, or if preferred, on the door of the bedroom closet, and then attach a metal strip as shown. The metal support may be of tin or sheet-iron, but if made of brass and nickeled it will have a much better appearance. The shoes are hung by the heels.—GEO. W. GREENE.



An Exceedingly Simple Arrangement for Keeping Your Shoes Out of the Way

How to Calculate Distances

IT is often necessary to measure approximate distances from one object to another quickly, as in photographing with a Kodak. An instrument that enables one to make such measurements can readily be made, using the angle of incidence as the principle upon which to work. Such a device, made according to the description, is simple and compact. It can be constructed either of hardwood, or sheet metal, cut to the size and shape shown in the illustration. Running along the top of the device is a sight tube, consisting of a small metal tube soldered or securely fastened with wire. A level, in the form of a metal hand, is fastened as shown, the hand being left free to swing back and forth along the face of the instrument.



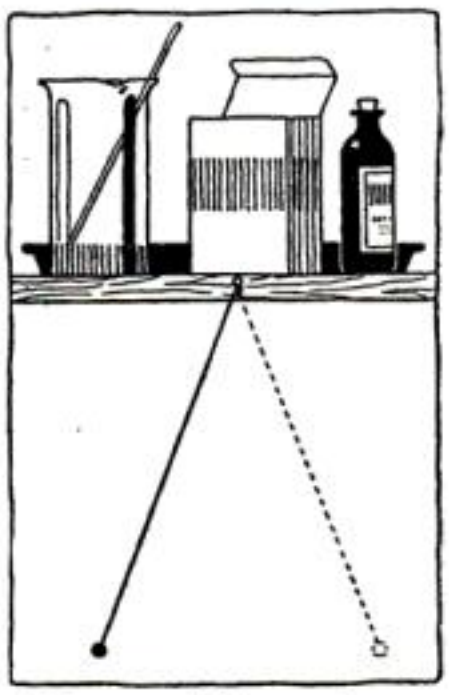
The Angle of Incidence Is the Foundation Principle

The device is now complete, except for the markings, which are determined as follows: Selecting a level ground, a distance of 100 feet is measured off. Standing at one end of the measured distance, sight through the tube to the base of an object placed at the other end of the measured distance. By base is meant the base line, or point of meeting between the ground and object. After carefully sighting in this manner, at the same time allowing the hand to swing free, the hand is now caught under a finger and pressed against the face of the instrument, to prevent further movement. A mark is now made at the point of the hand, and this indicates 100 feet in future measurements.

The other distances are measured in the same manner, care being taken always to be on a level ground; the measuring of the short distances can be done indoors very conveniently. Obviously, the nearer an object is to the observer, the more the instrument must be tilted to sight at the base line of an object, and vice versa. Therefore, to make accurate measurements of distances, the instrument must always be used by a person standing up straight, and one of the same height as the one who made the markings, for they would not be absolutely correct for anyone of different height. If extreme compactness is not a requirement, the instrument can be fastened to a rod, with a pivot, and this pressed into the earth to form a support, thus allowing it to be used by anyone. The object sighted at should always be on a level with the observer, in order that the proper distance between the two may be found. Such a device is especially valuable to the amateur photographer in determining the distance between his camera and the object to be photographed, and will greatly reduce the number of failures due to incorrect judging of distances.

Photographic Self Help

Pendulum for the Dark-Room

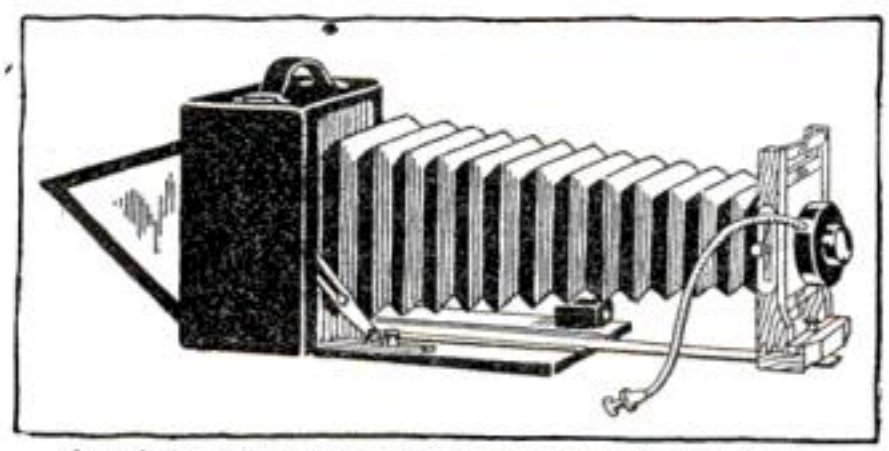


The pendulum swings from one terminal to the other in half a second

A SMALL weight fastened to a thread measuring 9¾″ in length and having a loop at the end to be hung from a hook in the edge of a shelf, makes a capital aid in counting seconds for timing the appearance of the image in the time system of development. One second counts at one end of the swing only, since the pendulum swings from one terminal to the other in half a second. The exact weight of the pendulum does not matter, the period of time depending upon the length, not the mass. This device may be so constructed as to count minutes. A small metal hand may be placed at the anchoring end of the pendulum. As the weight shifts from one terminal to the other the hand will be actuated against some object which will enable the operator to count the periods.

An Improvised Reflecting-Camera

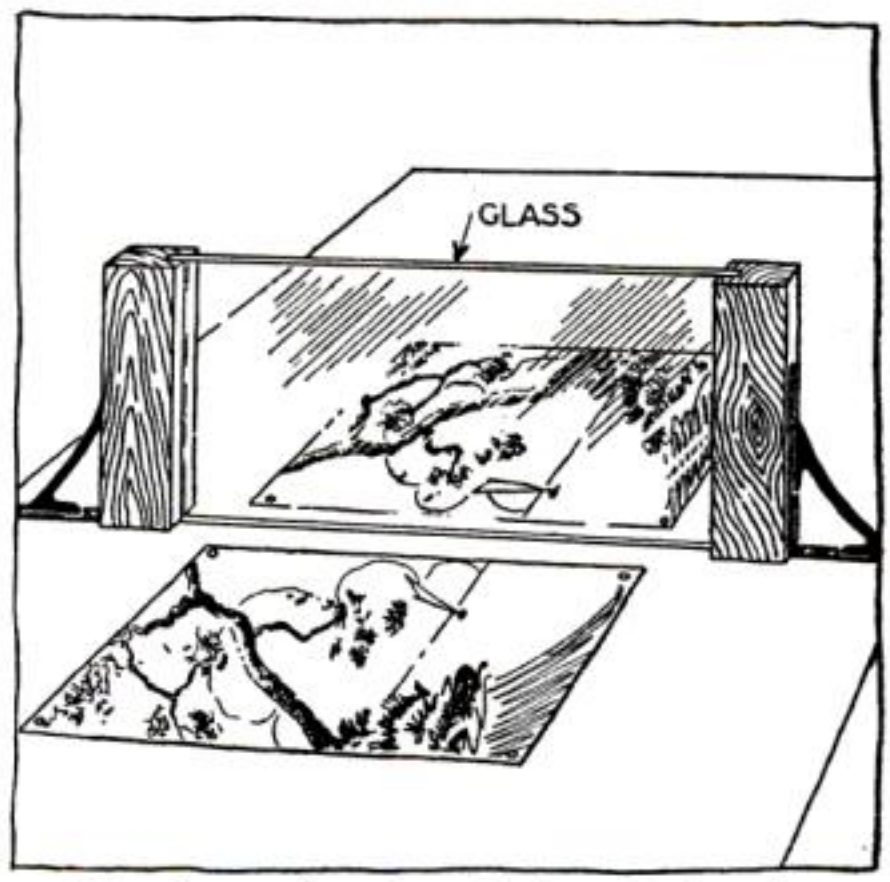
A VERY simple arrangement can be fitted to a hand-camera to enable the photographer to see the image on the ground glass, right side up, and without the use of a focusing cloth, while still holding the camera in the hand. This consists of an ordinary mirror, on thin glass, cut to the same size as the ground glass of the camera and mounted on the inside of the door covering the ground glass opening. The mirror is held at an angle of about 45° to the back of the camera by attaching a string or light chain to the door and the back of the camera. When it is desired to view the image on the ground glass the door is opened and allowed to drop down as far as the string will allow, and the eyes are placed at the top of the triangular opening thus provided. The image will be seen in the mirror, right side up.



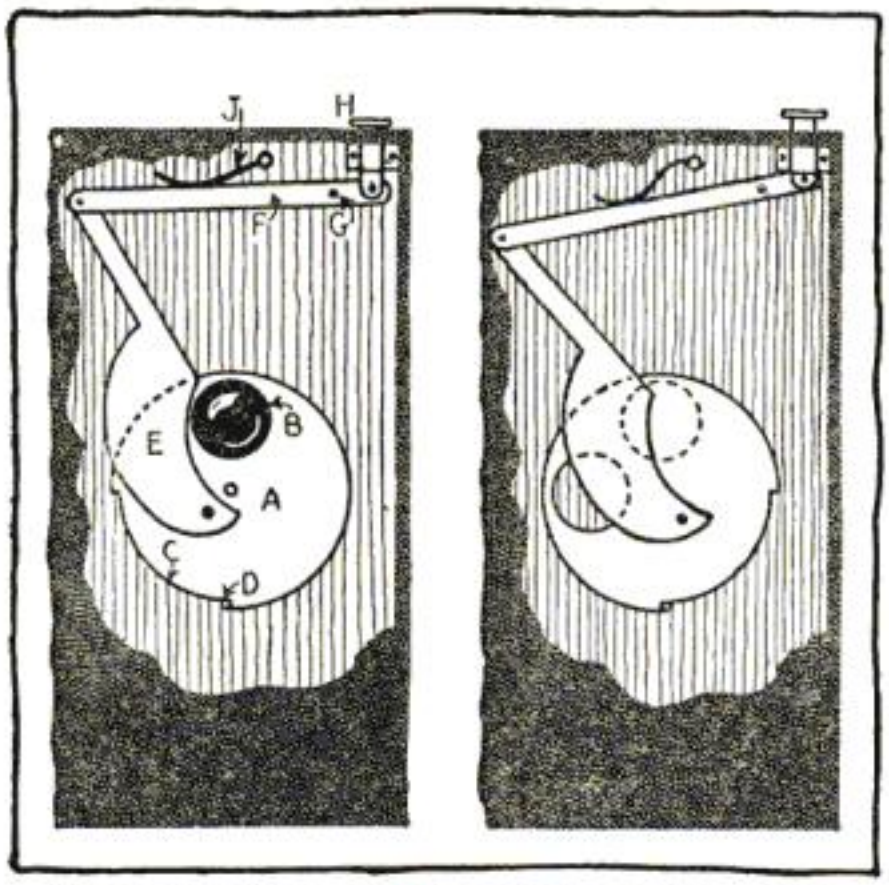
A mirror the size of the ground glass of the camera is mounted on the inside of the door

Novel Device for Copying Pictures

THE illustration shows a handy apparatus for copying pictures. A piece of groove siding is ripped in the center, and two pieces 12 ins. long are dressed on the edges. A piece of glass about 10″x16″ is required. Two brackets are placed on the strips which hold the glass. Using an old drawing board the brackets and uprights are screwed in place, allowing space between the uprights for the glass. A strip of felt is placed on each narrow end of the glass, which is placed between the grooves. The copier sits directly facing the glass, after placing the picture on the table and securing it with thumb tacks. The reflection of the picture can be seen through the glass and copied.



The picture is reflected through the glass and may be copied on blank paper with pen or pencil



When the plunger is pressed the action opens the shutter, and when the plunger is released blade returns to its former position

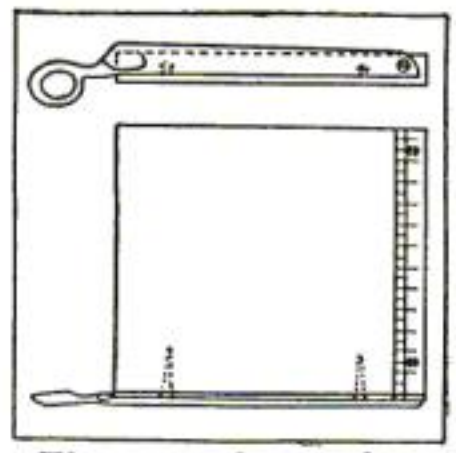
Home-Made Camera Shutter

A SHUTTER, which is suitable for a small hand-camera, can be made from odds and ends, and occupies a space $2\frac{3}{8}''$x$1\frac{1}{4}''$x$\frac{1}{4}''$. The blade, *A*, is made of thin hard brass, painted dead black, loosely pivoted at the center by a small screw.

It is $1\frac{1}{8}''$ in diameter, and it has a circular opening, *B*, for the exposure, $\frac{7}{8}''$ in diameter. A narrow piece is removed at *C*, the corners coming into contact with the stop, *D*, consisting of a small screw. A lever, *E*, is pivoted to the circular blade at one end and to a second lever, *F*, at the other, the fulcrum of the latter being a screw, *G*. The shutter is operated by pressing the little plunger, *H*, and remains open until the plunger is released, when the spring, *J*, returns the blade to its former position.

A Useful Trimming Board

A USEFUL cutting board for trimming photographic prints can be made from a scissors blade and a few odds and ends. The illustration shows the trimmer complete. The board is $1\frac{1}{2}''$ thick and of any convenient area, with part of a flat rule *B* screwed along the top edge. A strip of steel is screwed along the right hand side, flush with the surface. An old scissors blade is secured by means of a screw which forms a pivot or fulcrum, the necessary hole having been drilled through the end of the blade. It will be seen that the end of the blade has been ground blunt and the cutting edge straight. When cutting, the blade should be pressed towards the steel strip.

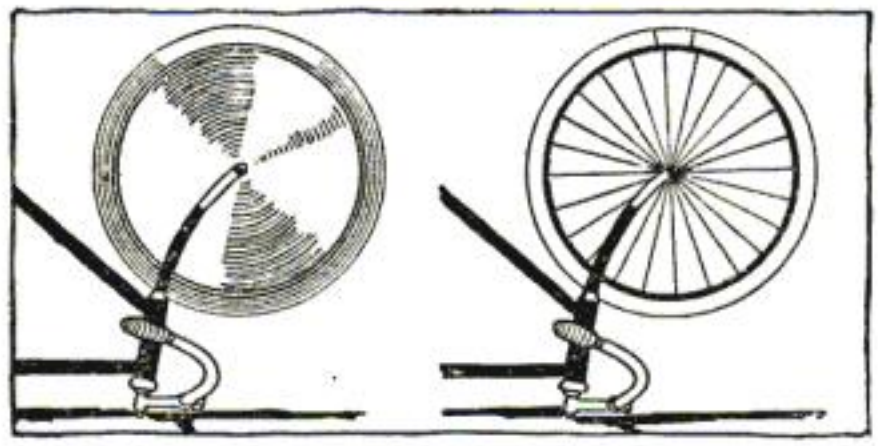


The complete trimming board for photographic prints made from a scissors blade

Simple Test of Shutter Speed

THE following method of testing the speed of a camera shutter may be of interest to photographers who possess a bicycle. Invert the bicycle upon a suitable support in bright sunshine, and glue a small square of tinfoil to the side rim of one of the wheels. Set up the camera in a convenient position and focus this wheel sharply. Then open the diaphragm to its largest stop and set the shutter at its lowest speed. The wheel must be revolved at the rate of one revolution per second and a shutter exposure should be made while it revolves at that speed.

The wheel should then be brought to rest and a time exposure given on a second plate. This constitutes a check in the alleged speed of a shutter.



Using a bicycle, set upside down, to measure shutter speed

A test can be made several times, and the final results carefully compared and noted. It is necessary in all cases to make two exposures to determine the shutter speed. The method is sufficiently accurate for all ordinary purposes and with a pair of dividers to measure the width of the image, there is little opportunity to error.

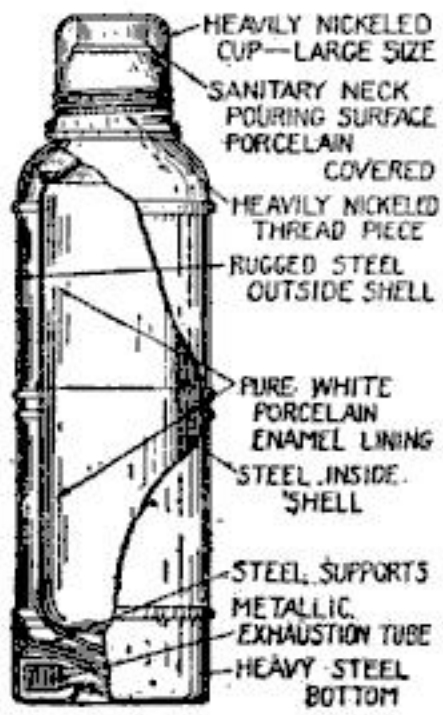
An Improved Vacuum Bottle

A NEW type of vacuum bottle made entirely of steel with a pure white porcelain enamel lining—will shortly be placed upon the market. The steel bottle is the invention of Mr. William Stanley, who perfected the bottle while engaged with other scientists, notably Dr. Irving Langmuir, in studying heat insulation.

This new bottle is non-breakable and the inventor claims about ten per cent. more efficiency for it than the glass bottles heretofore in use. It overcomes the well-known scientific fact that all metals have buried within them and condensed on their surface varying amounts of gases, which in their total amount to surprising quantities, being many times the actual volume of the metal. When a high vacuum is produced adjacent to a metal surface these gases free themselves slowly and for a long time continue to appear in the vacuous space.

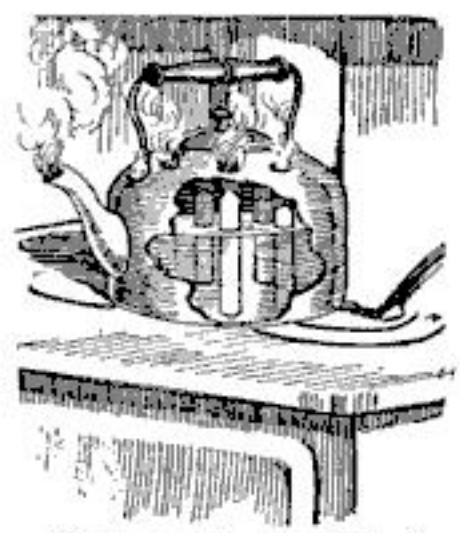
The inventor believes that this phenomenon of occluded gas was responsible for the failure to obtain in metal-wall vessels results obtained in glass vacuum-bottles. He, therefore, obtained the desired result, not by spacing the inner and outer wall extremely close together, but by filling the vacuous space between the walls with a very finely divided metal so prepared as to be incapable of giving off gas at a vacuum or even to be absorptive of gas in the vacuum. By this procedure each air space enclosed between the granules of the finely fitted material becomes a vacuous space of which the granules form the vacuum walls.

The bottle is made by electrical welding which makes the joints not only vacuum tight but stronger than the sheet metal itself. Although built up of a number of parts this container is one solid metal unit when completed. The method of construction eliminates all danger of breaking at the joints. In fact the bottle is claimed to be practically indestructible under even the most strenuous usage short of smashing with an axe with malicious intent.



Water May Be Boiled in One-Third of the Usual Time

Facilitates Boiling Water



Vacuous Space Filled with Finely Divided Metal

THIS novel idea of a tube-kettle will be found to give very satisfactory results where water is required to be boiled in one-third to half the usual time.

The sketch shows an ordinary kettle so fitted, five holes being bored to correspond, both top and bottom.

In these holes tubes of half-inch to one inch bore are fitted, the bore varying according to the kettle's size, after which they are well soldered to prevent leakage.

Kettles fitted with these tubes are suitable for use on either gas stoves or a closed range, and are also rendered suitable for open grates by fitting corks in the top of the tubes to prevent any smoking.

Practically all kinds of kettles may be readily converted into tube-kettles in this way.—GEORGE M. HOLDEN.

Using Waterproof Lutes

BOILED linseed oil, thickened with clay, asbestos, or red or white lead, forms a good waterproof lute. Care should be taken to make it thick enough.

Flaxseed meal made into a stiff paste with water is useful for steam connections and is easily applied.

Portland cement is waterproof only when given time for preliminary setting to take place. It is not generally impervious to water, and because of its colloidal character while setting, it seems incredible that it could ever act other than as a water-pervious diaphragm. When firmly set and dry, however, the colloid character is lost. For practical purposes, preparations containing metallic soaps or oil emulsions serve to render concrete approximately impervious to water.

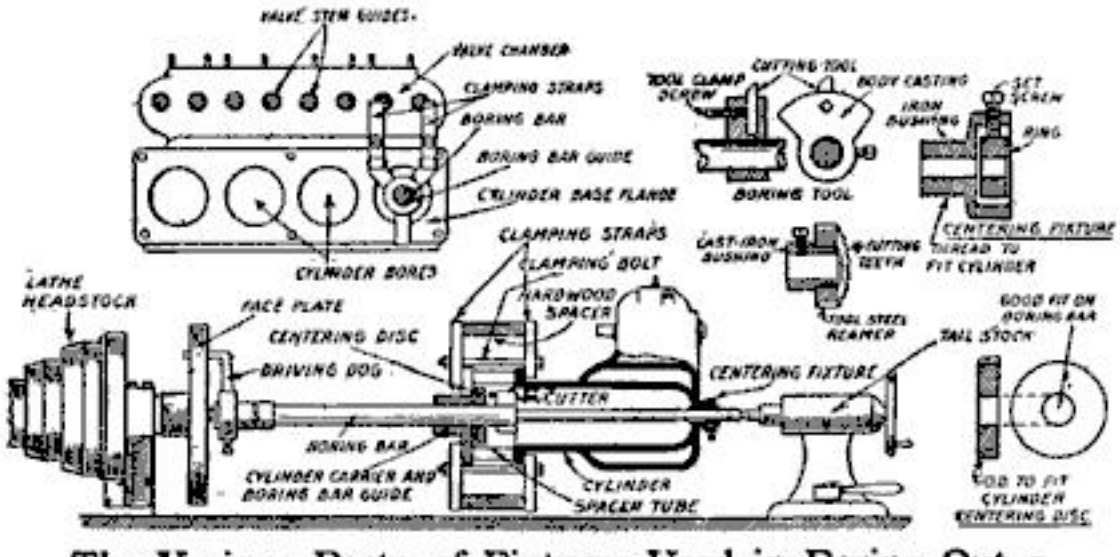
For Practical Workers

Boring Cylinders with a Lathe

THE average automobile repair man does not have a very extensive machine shop outfit, yet he is often called upon to do repair work of considerable magnitude with very ordinary equipment. After automobile engine cylinders have been in use for a time, the cylinder bore is apt to be worn or scored from a wrist-pin loosening. The only possible method of repairing a cylinder that has depreciated to that extent is to bore it out. A job of this nature was done on a 14-in. swing lathe by the use of relatively simple and inexpensive fixtures.

The repair man had several scored cylinder castings belonging to a car that is no longer manufactured, and as there was a number of these cars in use in the vicinity it was considered more economical to salvage the worn castings which were otherwise in perfect condition and have them in stock than it would be to purchase new parts. The cylinders, which were initially about 3 5/8-in. bore, were enlarged to 3 3/4-in. bore and oversize pistons and "leak proof" rings were fitted. The cylinder wall was of ample thickness to permit boring.

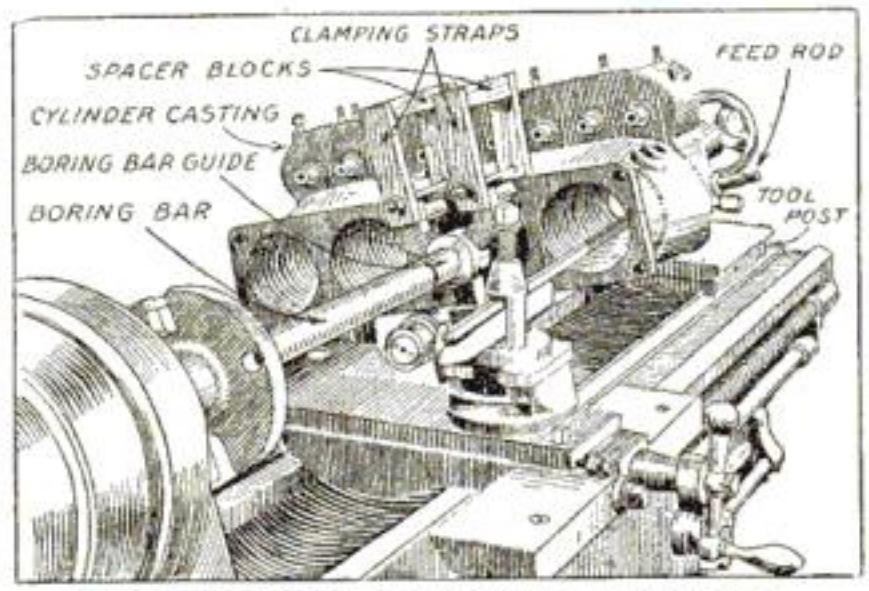
The boring-bar guide used to support the open end of the cylinder block and the method of fastening this by clamps is shown in the illustration. The arrangement for feeding the cylinder-block by attaching it to the tool post of the lathe by means of a rod or key stock is also outlined. The other end of the key stock is clamped to the top of the cylinder and as the tool post carriage is fed down by the feed screw it is evident that the cylinder-block will also be pulled down on the boring-bar. The construction of the boring-bar and fixtures may be readily determined by examining the diagrams. A three-diameter boring-bar was used, two of the diameters being very accurately turned. The cylinders were provided with a threaded hole at the head end which was normally closed by a brass plug. This hole was furnished as a core print support when the cylinders were cast. A centering fixture was made to fit this hole. This was a cup-shaped iron bushing having three equidistantly spaced set-screws bearing against a centering ring which was bored out to be a good sliding fit on the smaller



The Various Parts of Fixtures Used in Boring Out a Cylinder on a 14-inch Engine Lathe

diameter of the boring-bar illustrated.

A three-arm spider casting having a substantial boss was bored out to be an easy running fit on the intermediate diameter of the boring-bar. This was securely held against the cylinder base-flange by means of clamping straps. It is held away from the base-flange by tubular spacers while the clamping straps were separated at the top by hardwood spacer blocks. The boring tool was a special iron casting having an inserted cutting tool made of tool steel. The cutter was held in place by a set-screw and was inserted in a drill hole made to receive it. The boring tool was securely clamped to the intermediate portion of the boring-bar by a set-screw. A special reamer was made to smooth the cylinder after the boring cut was completed. This was made of a tool steel disk having sixteen cutting teeth milled on it and forced on a cast-iron bushing which was a good fit on the boring-bar. The boring-bar was machined from a piece of machinery steel 1½ in. in diameter.



Boring-Bar Guide and Method of Fastening It with Clamps

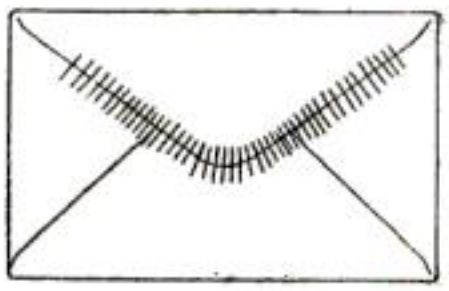
In assembling the parts, the first step was to put the centering disk into the cylinder interior and then locate the cylinder carriers and boring-bar guides. The centering disk was an easy push fit in the cylinder interior and, of course, held the boring-bar in the center. When the cylinder carrier was clamped to the base flange of the cylinder-block, and the centering disk was backed out and its place taken by the boring tool, the cut started straight. Absolute parallelism of the boring-bar with the cylinder walls was secured by putting the centering disk at the head end of the cylinder and then adjusting the centering fixture screwed into the core print hole so that the guide ring would support the head end of the cylinder properly on the small diameter of the boring-bar. After the centering disk had been moved to the open end of the cylinder and the boring-bar guide securely clamped thereto, it will be apparent that the boring-bar center line had to coincide with that of the cylinder.

The cutting tool is set for the desired depth of cut, leaving about 1/64 in. of stock on a side to be removed with the reamer. The lathe is started on the back gears and the cylinder-block is moved back slowly to meet the cutting tool by moving the tool post carriage with the hand feed. As soon as the cut is started the power feed is adjusted for a fine cut and the regular feed screw is used to bring the cylinder casting down. Only one cut is taken with the cutting tool, this being afterwards removed and the reamer substituted to finish the job. As the cylinder-block floats on the boring-bar and as the guide members must be accurately located initially by the centering disk provided, the new bore must be true to size and the walls parallel to the center line of the cylinder.

It took about ten hours to bore and ream four cylinders or one cylinder-block. The setting up and locating took about two hours while the cutting occupied the remainder of the time. The cylinder flange rested on the ways of the lathe, this resisting the tendency of the cutting tool to turn the cylinder casting about the boring-bar. The weight of the casting was enough to prevent any vibration or chattering due to movement of the cylinders. In doing a job of this kind it is essential that the cylinder be accurately located on the boring-bar. The guide bearings should be thoroughly oiled and should be a good sliding fit on the arbor without having any vertical movement or shake. The boring tool should be carefully sharpened and it is absolutely essential that it be fed in slowly, so that only a fine cut will be taken. There is no necessity of blocking up the cylinder casting as this is adequately supported.—JOHN B. MAYNARD.

How to Safeguard Mail Against Meddlers

TAKE an indelible pencil and make light lines—as shown in drawing—on the back of the envelope. Do not wet pencil when making the lines, and it is not necessary to bear heavily on the pencil; for if the envelope should be steamed the lines made with the indelible pencil will turn to a bright purple and remain plainly visible as shown in the illustration.



The Purple Lines Say, "This Envelope Has Been Steamed"

A Substantial Home-Made Jack

A SUBSTANTIAL jack of considerable lifting power is made with two pieces of 2 by 4 or 2 by 6 hardwood, two bars of steel or iron and a few bolts.

Cut one piece of the 2 by 4 about two or three feet long, according to the height desired for the jack. Cut another piece about 12 ins. long for the base, and fasten to the end of the upright piece, as in Fig. 1, by nailing or by mortising. Now bore ¾-in. holes near the edges of the upright on each side about 3 ins. apart and staggered as shown in Fig. 1. Put ¾-in. bolts in these holes with washers on both ends and screw nut up tight. It is best to use two nuts on each bolt.

Fig. 2 is a sectional side view of the upright, showing the bolt through the timber with two nuts holding it in place.

Procure two bars. One should be about 4 ft. long for the lever. In this cut a notch about 4 inches from the end. The other bar is about two ft. long, with a chisel point on one end. An elbow bolt or large staple is placed near the top for the short bar to pass through to prevent the jack from kicking under a load. A 4-in. block is now cut and placed on top of the upright bar to prevent the bar cutting into the object being lifted.

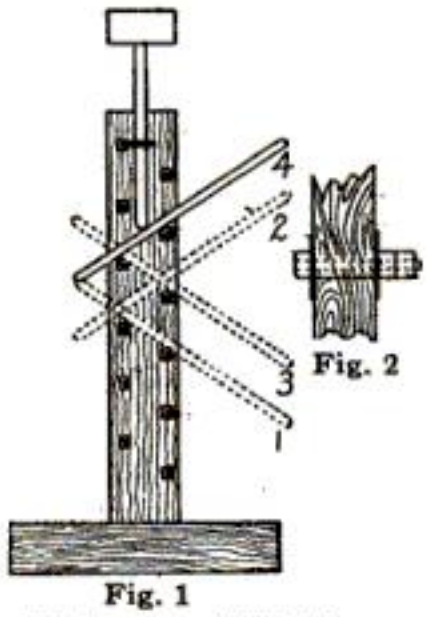


Fig. 2

Fig. 1

This Jack Will Not Kick or Cut Into the Object Lifted

The lever bar with upright bar set in notch to prevent slipping is worked up from the nuts on one bolt to those on the bolt just above, as in Fig. 1. Dotted lines show different positions of lever bar in operation.—ROBT. F. STAYTON.

A Case for Miniature Lamps

PROCURE two pieces of wood 2 ins. by 6 ins. by ⅞ in. Draw a line lengthwise through the center and then mark off every ¾ in. on this line.

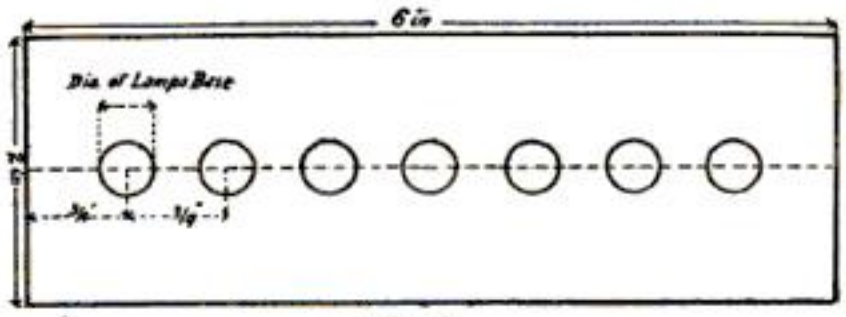


Fig. 1

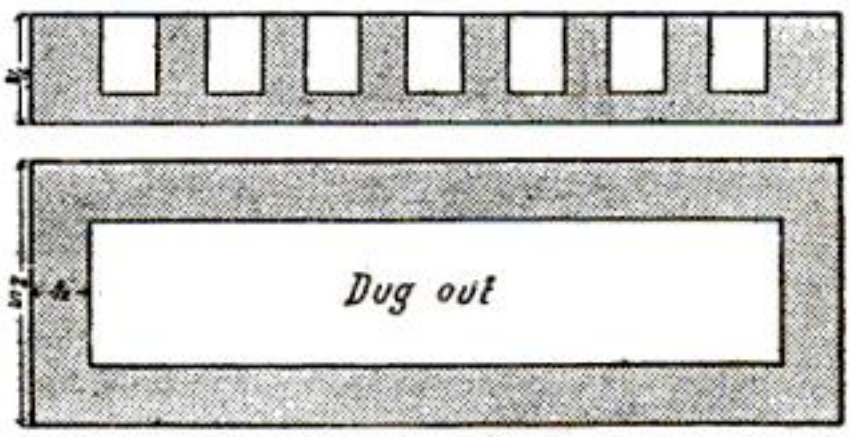


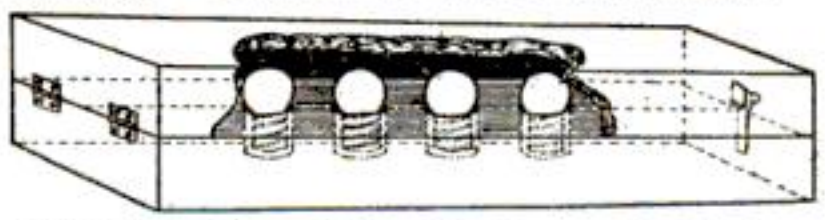
Fig. 2

Diagram Showing Parts of Box Finished and Ready for Assembling

Drill holes with a bit the size of the lamp's base and drill them deep enough to allow the lamp to rest in, as in Fig. 1.

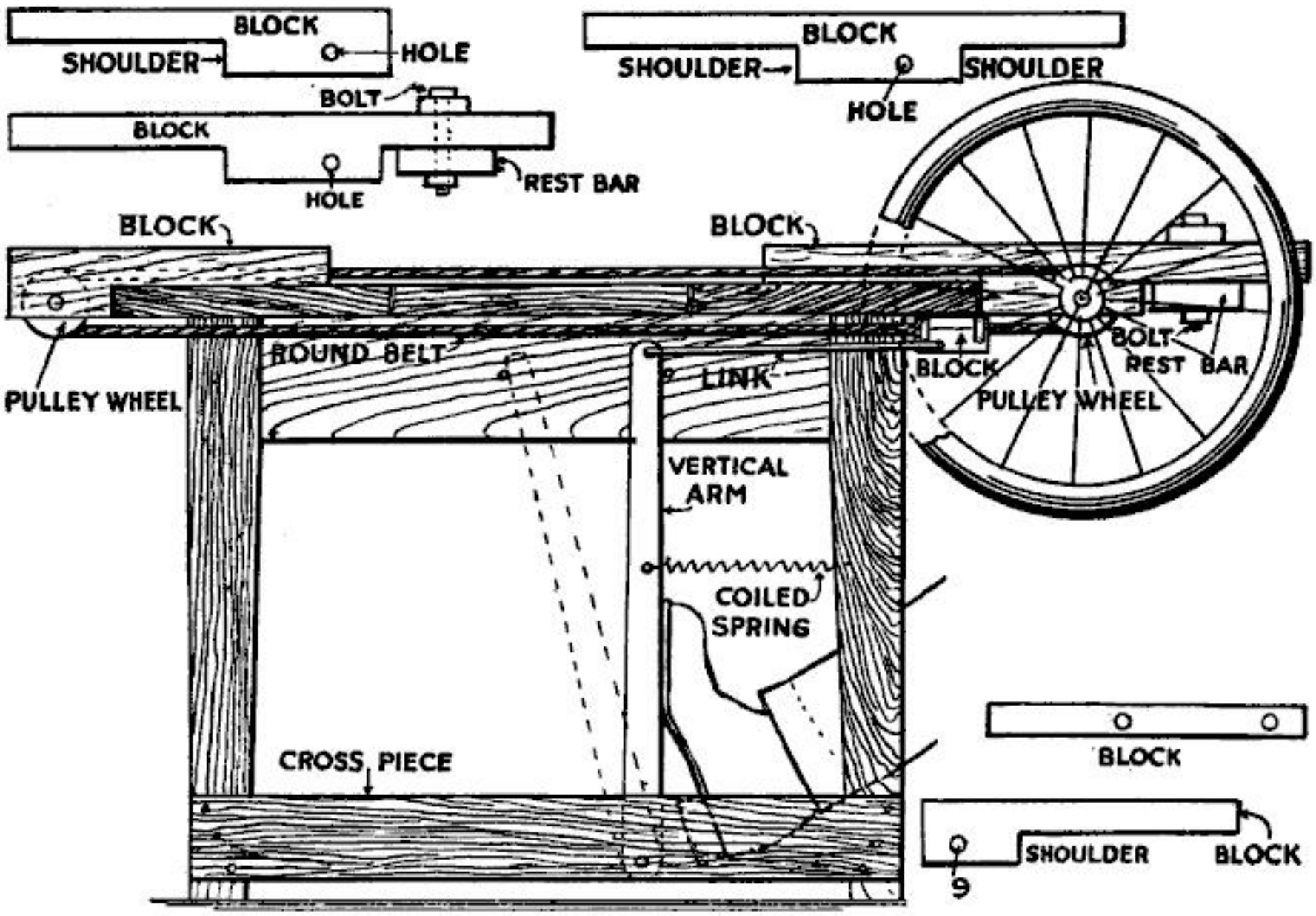
Take the other piece of wood and measure ½ in. from the edge on all sides, making a rectangle which is to be dug out to a depth of ½ in. This is shown in Fig. 2.

Next place the two together and fasten a small hinge to one end and a catch to the other end. The case is now complete except for sandpapering and painting.—CHARLES. W. CHRISTMAN.



The Case Complete with Lamps in Position in Their Sockets

Making a Wood-Turning Lathe



The Illustration Tells the Story of the Metamorphosis of an Old Discarded Kitchen Table Into a Piece of Machinery for Practical Mechanics

IN the corner was an old kitchen table. That was the only thing handy to be used as the framework in making a wood-turning lathe. A block of spruce 2 ins. thick, 3 ins. wide, and 15 ins. long was first prepared. This had one end thinned down for a distance of 6 ins., and the other end treated in like manner 4 ins. to a shoulder, thus leaving a part 2 ins. thick in the middle portion, through which was bored a cross hole with a three-eighth bit, 3 ins. from the shoulder. A slot 1 in. wide was then cut through the block, extending in 7 inches.

Another block 2 ins. thick, 1½ ins. wide, and 11 ins. long, had one end thinned down to correspond with the thinned portion of the first block, and a hole bored through to register with the hole in the first block.

These two blocks are screwed to the table top at its corner, and the holes are in line with each other to receive the mandrel. Obtain 2 pcs. of round three-eighth steel, one 12 ins. and the other 4 ins. long. Also obtain a couple of V-grooved pulleys. A bicycle repairer can fasten them to the mandrel and spindle. One of them was secured to the mandrel 5½ ins. from the end, and the other was fixed to the spindle midway between its ends.

One end of the mandrel thus made was filed square, and the other end of the mandrel carried the bicycle wheel which was easily attached. Two blocks were then made, each of 2 by 2-in. material, 10 ins. long. The lower side of each was then thinned back a distance of 6 ins. from one end to the shoulder and a cross hole with a three-eighth bit bored through the thick part of each block, so they registered. These blocks thus served as bearings for the spindle, so the wheel was located at the rear edge of the table, directly in line with the wheel on the spindle at the front edge of the table.

To impart motion to the mandrel, a hardwood block was cut out, 2 ins. long,

¾ in. thick, and ⅞ in. wide. A ¼-in. hole was bored through this from end to end above the center or middle line. A pair of links of thin metal on each side were attached by pivot pins at the ends to the sides of the block, and afterwards one end of each link was detached and the block sawed through along the bore, after which the block was placed on the round belt, which connected the two grooved pulleys, and the ends of the links again attached.

By this arrangement the two parts of the block move back and forth a limited distance independently of each other, and in doing so clamp the belt between them. A triangularly-formed stop was attached to the upper member of the block, so that one edge projected down alongside one of the links, and thus limited the movements of the blocks relative to each other. The dotted lines show the swing of the links when the lower part of the block is drawn to the left.

To move the lower part of this block to the left, and thus grip the belt, attach a cross-piece by nailing to the lower ends of the table legs. The upper end of this arm is connected with the block by a link which is made of ⅛-in. telegraph wire. A coiled spring with one end attached to the arm and the other to the table leg, serves to draw the upper end of the arm back, when it is released by the foot.

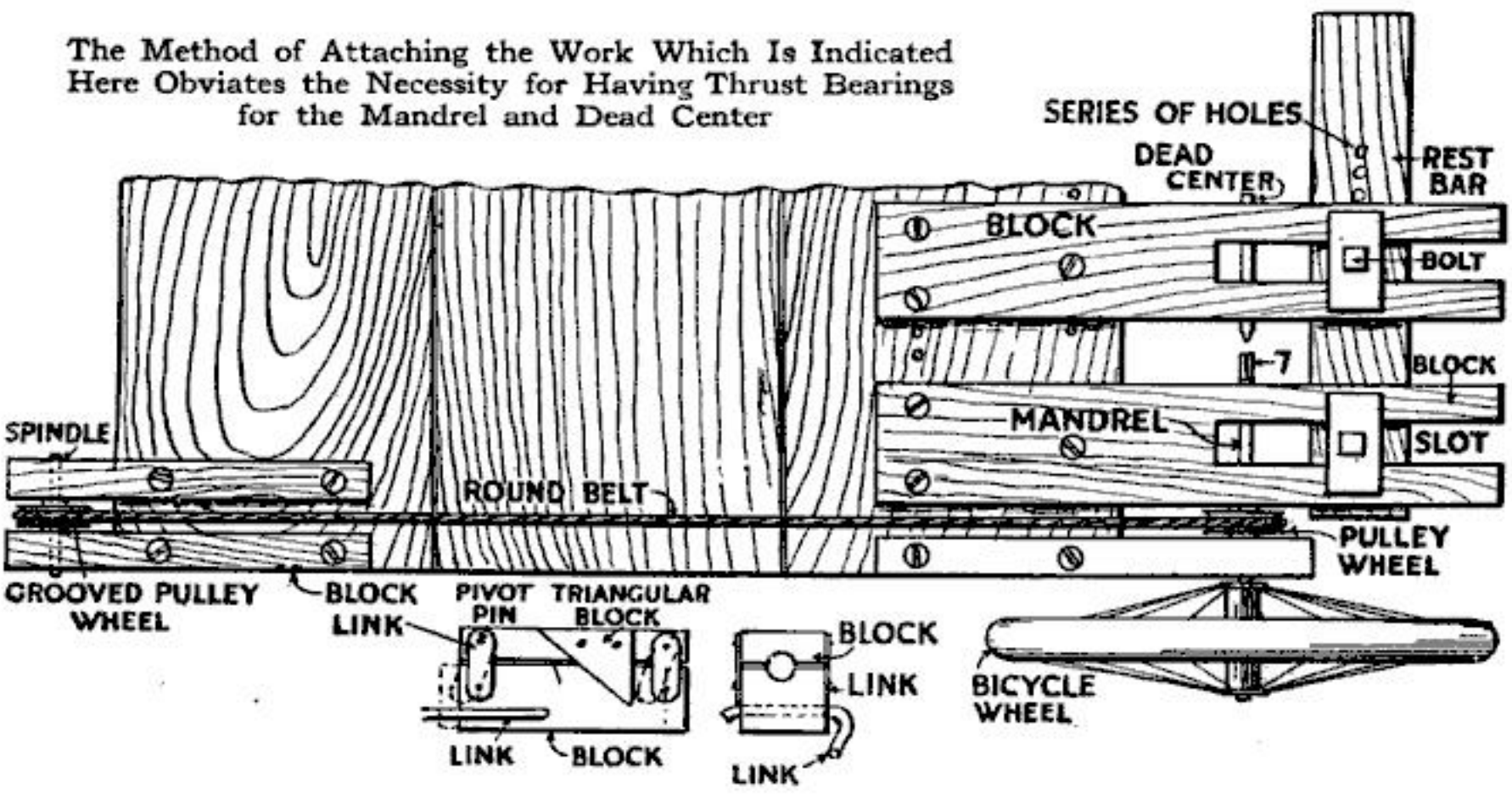
The dead center was fixed to a block similar in all respects to the first block and is secured to the top of the table by screws so it can be moved to and from the block. A rest bar with a series of holes was adjustably attached to the lower sides of the blocks by bolts so it might be moved to or from the lathe centers. The square end of the mandrel, if driven into a round 5/16-in.-hole in the end of the piece to be turned, holds it firmly, and this method of attaching the work obviates the necessity of having thrust bearings for the mandrel and dead center.—J. S. ZERBE.

A Bottle Pocket Lamp

A SIMPLE and safe pocket lamp that will last for about six months without extra cost can be made at home.

Have the druggist take a strong vial of clear glass, or a pill bottle with screw or cork top, and put into it a piece of phosphorus about the size of a pea and fill the bottle one-third full of pure olive oil which has been heated for fifteen minutes. Care should be taken not to boil it. Cork tightly, and the result will be a luminous light in the upper portion of the bottle. If the light becomes dim, uncork and recork again. The lamp will retain its brilliancy for about six months, and there is no element of danger in connection with it.—A. V. BOLLERER.

The Method of Attaching the Work Which Is Indicated Here Obviates the Necessity for Having Thrust Bearings for the Mandrel and Dead Center



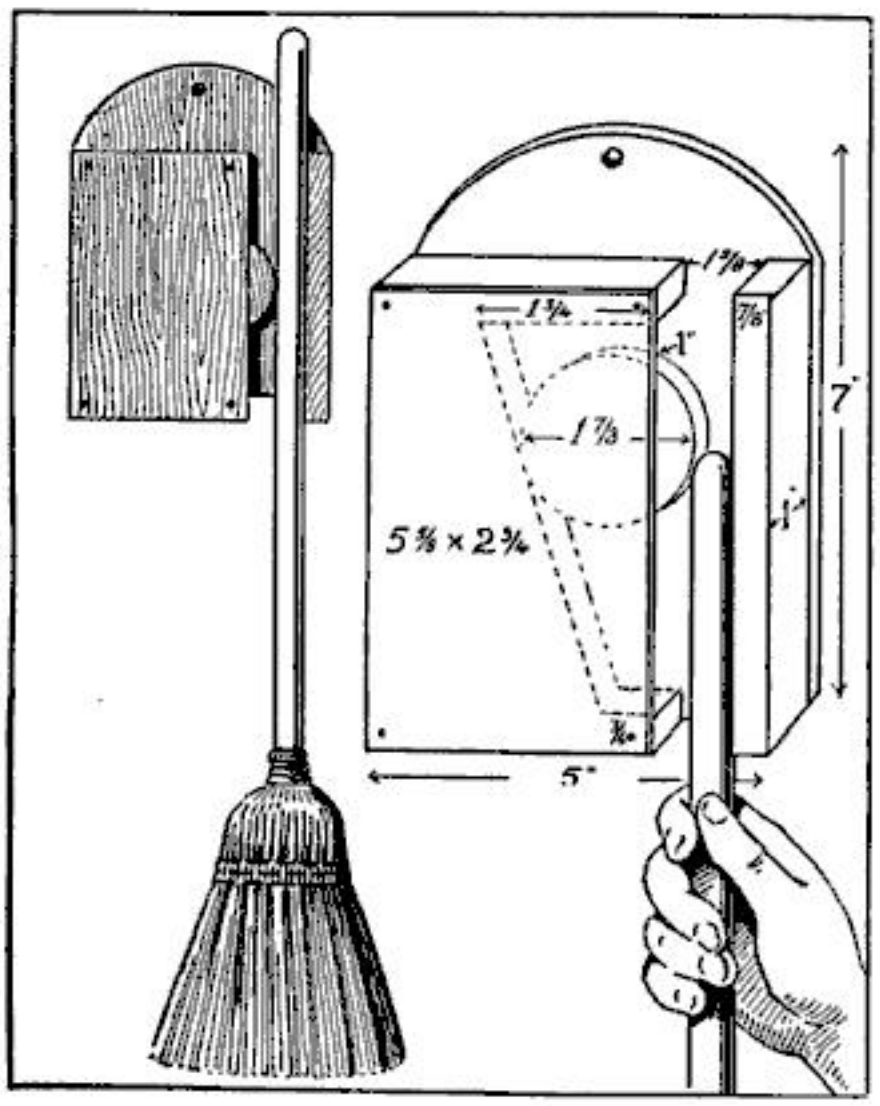
An Easily Constructed Holder for the Broom

A SIMPLE little article which may be made by a novice from a few pieces of wood is a holder for a broom. It is designed to lengthen the life of the broom by saving the wear on the bristles and also to operate automatically.

Take a board 5 ins. by 7 ins. by ½ in. thick, and round off the top 1⅜ ins. to hang up holder, as shown in the illustration. Take a 1-in. board 5⅝ ins. by 2¾ ins., cutting out a slot, ¾ in. from the top, 1¾ ins. wide, tapering to 1 in. at ¾ in. from the bottom. Cut out a circular disk 1 in. thick and 1⅞ in. in diameter and place this in the slot. Nail on the long edge a 1 in. strip, ⅞ in. wide, which will leave a space 1⅜ ins. wide between the strip and part containing the circular disk.

To complete, nail across the front a piece of ⅜-in. board 2¾ ins. by 5⅝ ins.

When hanging up the broom place the top of the handle in the groove, push upwards, and let go. The circular disk will fall into place, securely locking the handle. To release broom, push upwards.—HENRY C. FRANKE, JR.



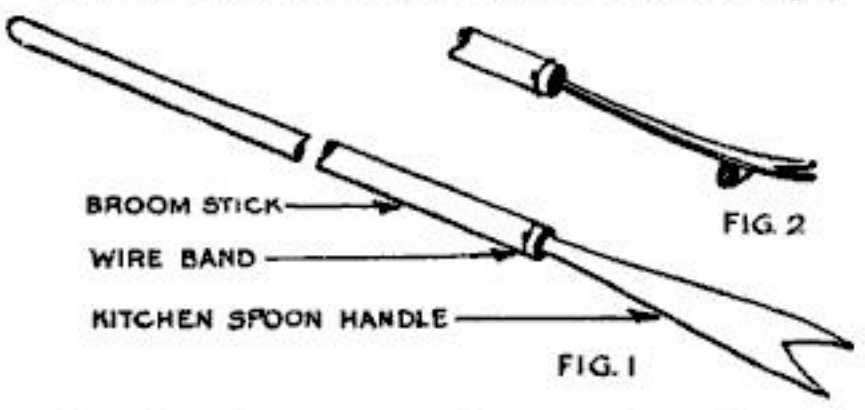
Showing the Automatic Action of Circular Disk Which Holds Broom in Place

A Weed Destroyer from a Spoon and Broom-Handle

A HANDY weed destroyer for use on the lawn is made of the handle of an old kitchen spoon and a broomstick. The eye of the spoon handle is cut out with a file, leaving two prongs, as shown and the inside edges are then sharpened and the small end of the handle is set in the end of a broomstick, Fig. 1.

With this tool one may easily and quickly cut off small weeds an inch or so below the ground without disturbing the sod.

If one prefers to pull the weeds, simply



The Two Prongs are Sharpened so They May Be Used Simply to Cut Off the Tops or to Uproot Weeds

nail a small block of wood to the underside of the tool near the prongs to form a fulcrum, Fig. 2. The weeds may then be pried out of the ground, roots and all.—F. H. LINTHIUM.

Correcting Pliers Which Bind

ELECTRICIANS know how tiresome and annoying are pliers that are difficult to operate. This binding results because the pliers have been dropped upon a hard surface or have been held in the flame of a blow-torch when holding terminal lugs for soldering.

This trouble can be remedied by wrapping a wet rag around the jaws, and leaving the joint exposed. The joint is then heated in the flame of a blow-torch, care being taken to have the rag thoroughly wet while heating, to avoid drawing the temper out of the jaws.

When hot, remove the rag and immediately plunge the pliers in cold water, closing and opening the jaws to their full width until they are cold. Dry thoroughly, and apply oil to the joint by working it in. After this process your pliers will work as easily as ever.—GEORGE NIEDERHOFF.

A Child's Morris Chair

THE drawing and illustrations are for a Morris chair suitable for a child from six to twelve years of age. A number of them have been successfully made in the eighth grade of New York City schools.

With slight changes in the dimensions, such as one inch added to the length of the legs, and an inch wider and deeper, the chair fits a boy or girl from twelve to fifteen years of age.

All the lumber can be bought mill-dressed to exact dimensions, given below.

BILL OF MATERIALS

Finished dimensions:	
4 Legs	1¾" x 1¾" x 16"
2 Front and back rails	¾" x 3" x 17½"
2 Side rails	¾" x 3" x 18"
2 Arm pieces	¾" x 3½" x 26½"
4 Slats (for sides)	⅜" x 4" x 7¼"
2 Supports for seat	¾" x 1¼" x 14½"
2 Stiles for back	¾" x 2" x 18"
4 Rails (for back)	¾" x 2" x 9½"
2 Front pieces for seat	¾" x 2" x 12¾"
2 Side pieces for seat	¾" x 2" x 15½"
4 Brackets	¾" x 1½" x 2"
1 Stick (rest for back)	¾" x ¾" x 18"
1 Dowel rod	½" diameter

The cost of all lumber and upholstering, including a good quality of imitation leather for the seat and back, amounted to $1.75.

Begin by laying out all mortise and tenon joints on legs and rails. The tenons are 1½ ins. long and the mortises are ¼ in. from the outside of the legs. The ends of the tenons are beveled, 1 in. from the shoulders, so as to obtain the largest possible gluing surface. The slats at the sides are not tenoned but "housed in," making the mortises in the rails very accurate. This extra care saves the time which is required if tenons are cut on the slats.

The legs are tenoned and project ⅛ in. above the arms. Four brackets shown in the drawing are glued under the arms and help to strengthen them.

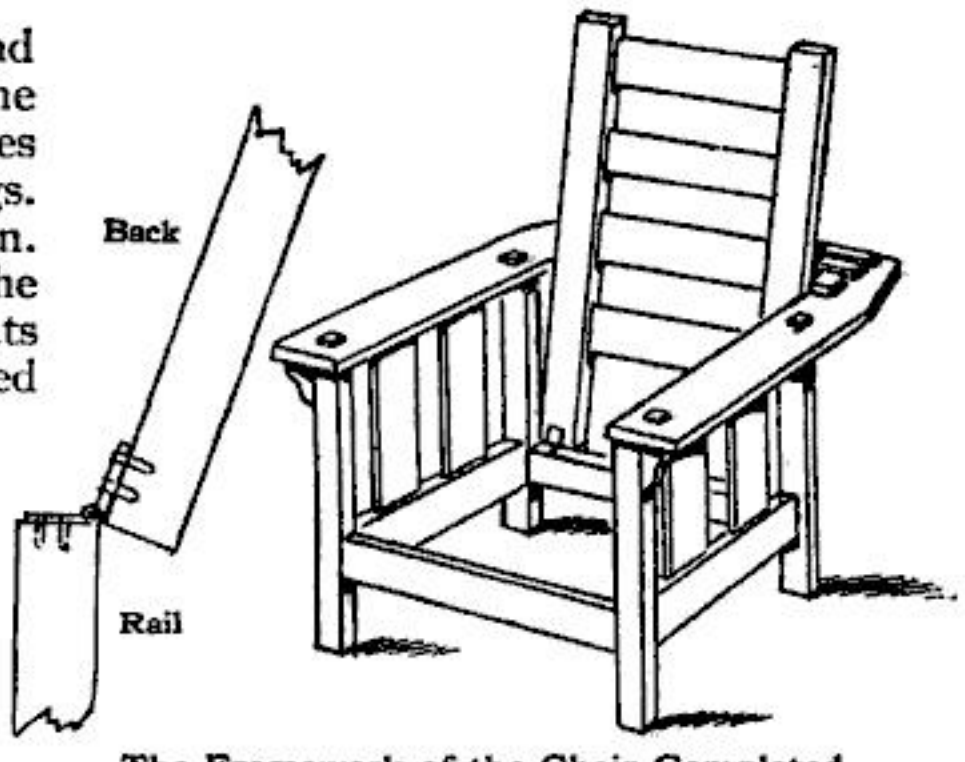
While the parts are gluing, the back is made and assembled. The parts of the back are doweled and glued. When finished it is hinged to the back rail as shown in the drawing. This enables the back to fold forwards as well as backwards, and prevents it from being wrenched off.

At the rear end of the arms are three plugs which are mortised in, to a depth of ½ in. in front of where the cross stick rests which adjusts the back to different angles. Great care must be taken in laying out and gluing these plugs, as they must be exactly the same distance from the rear legs.

To finish the chair, scrape and sandpaper all surfaces. Be sure to remove all surplus glue. Choose color of stain desired. An oil stain is the easiest to apply and will give satisfactory results. After applying the stain wait until the gloss disappears, then rub down with cotton waste. Allow the chair to dry for forty-eight hours, then apply two thin coats of shellac, and rub down with oo sandpaper, oo steel wool. A few drops of sweet oil on the sandpaper will improve the polish.

The seat rests on cleats fastened to the front and back rails. The cleat on the back rail should be about an inch lower than the one on the front rail.

The seat is made as follows: Construct a frame of material, 2 ins. wide and



The Framework of the Chair Completed To the Left is the Hinge Connection

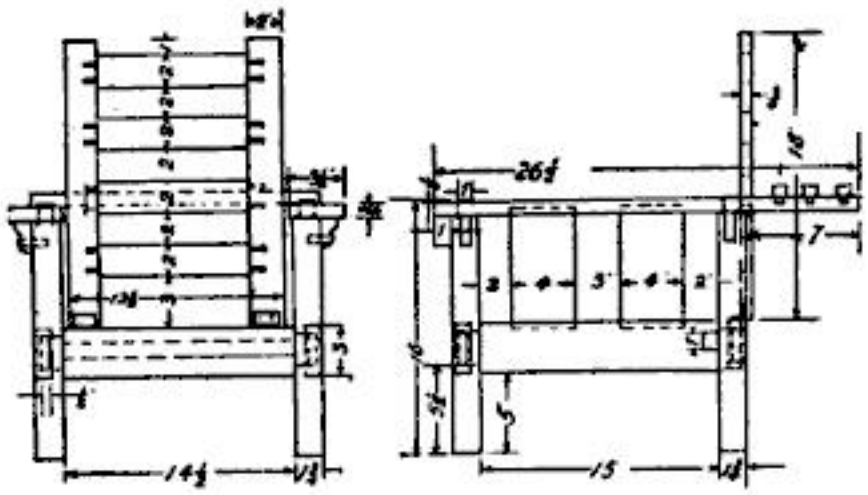
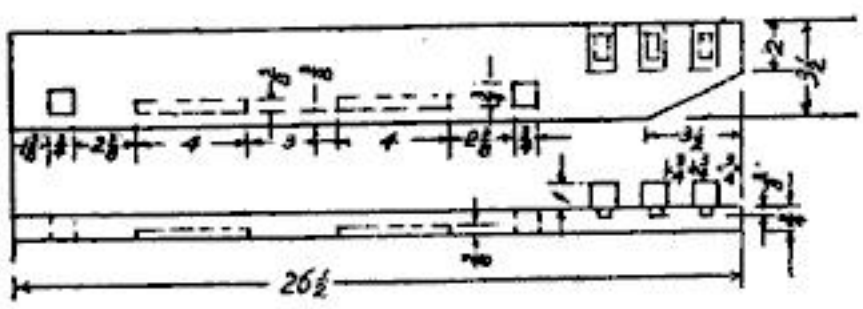


Diagram of Framework Before Assembling, Indicating Proportions and Process of Construction



At the Rear End of the Arms Three Plugs Are Mortised In. In front of These the Cross Stick Rests

large enough to fit the chair. It should not be flush with the front rail, but an allowance of ¼ in. should be made for the covering. Upholstering springs can be bought to fit the frame. After nailing on the springs, cover the frame with a particularly strong piece of burlap or canvas.

On top of the canvas, spread about a pound of cotton felt, moss, or hair, and cover the whole with leather or a good quality of imitation leather, which can be tacked underneath the frame of the seat. Use 6-oz. upholstering tacks. Be sure to stretch the leather and see that no wrinkles are formed. For the back sew up a cushion and stuff it with cotton felt. When cutting the material for the cushion make it about 3 ins. wider than the distance between the arms, so as to allow for the seam and the stuffing which tend to contract the cushion. This additional width also gives the cushion space to spread when a heavy person sits in the chair.

This comfortable chair will present an excellent example of craftsmanship and will make a fine Christmas gift, the season for which will be here almost before you can realize it. So it is none too early to get busy at the workbench.—ANTON BUCHBINDER.

An Efficient Tin Pump

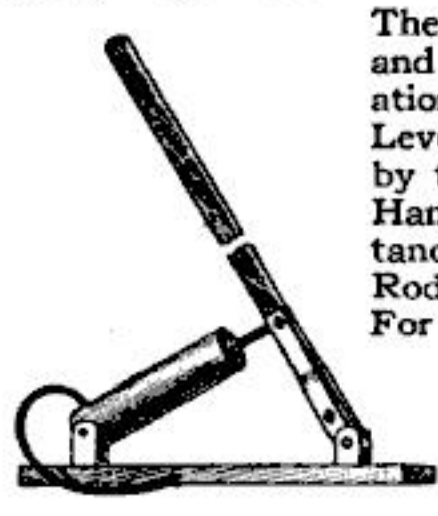
A TIN pump can be made by taking a piece of brass tubing two ins. thick and seven or eight ins. long for the cylinder. A piece must be turned in the lathe to stop up one end and furnish a bearing for the cylinder to rock upon. Next a plunger-rod and piston should be made.

The best way to make the piston is to turn out washers about 3/16 ins. thick, with one slightly smaller than the inside diameter and the other ¼ in. smaller to allow for the leather cup. Both of these washers should be tapped with a ⅜-in. thread.

The plunger-rod is made about one inch longer than the stroke and a hole ¼ in. is drilled in the outer end. A small cap or guide for the piston-rod is then turned to fit in the cylinder and is held in place by three screws. A hole ¼ in. is then bored at the base of the pump and a small tube soldered or threaded in to carry the rubber hose. These fittings can be taken from an old discarded bicycle pump.

Next a board eighteen ins. long and five ins. wide is used. A piece of band-iron 1 by 3/16 is bent and drilled to act as a bearing for the pump. A handle three feet long is shaped and two iron bands drilled and bolted at the base to form a bearing for the handle to rock back and forth and carry the pump-rod. A small slit is cut about eight ins. from the base of the handle and a bolt is run through. This is to hold the pump-rod. A bent iron bearing is made for this handle the same as for the pump itself.

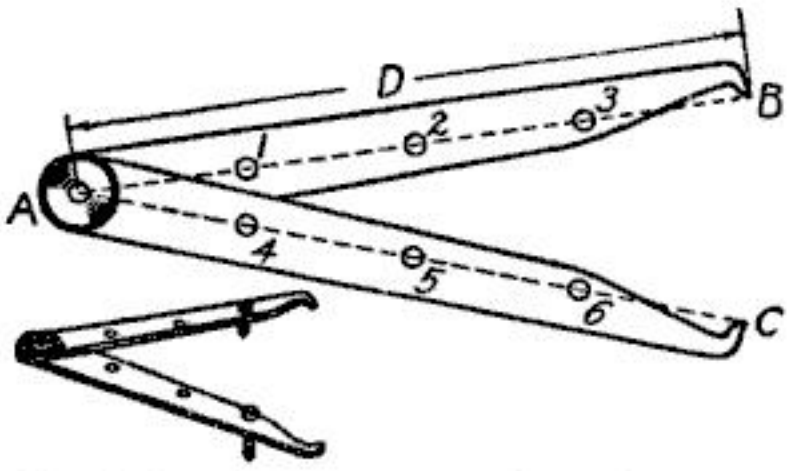
The amount of leverage can be regulated by the length of the handle and the distance of the plunger-rod from the base. This pump takes about one-half the energy that an ordinary tin pump requires.



The Pump Completed and Ready for Operation. The Amount of Leverage Is Regulated by the Length of the Handle and the Distance of the Plunger Rod from the Base. For Ordinary Use the Length Is About Three Feet

Scale Reading Calipers

IN the shop it is often necessary for the workman to read dimensions from blueprints that are half size, three-quarter size, etc. The usual practice is to caliper the dimension, transfer it to a ruler, and multiply it in order to get the actual size. It is a very simple matter to fix up your calipers so that they will be



Method of Improving Calipers So as to Eliminate Involved Calculations

ready directly, thus giving the full size without any calculation.

Measure accurately the distance *A*, *B*, and divide it into four equal parts. In the same way lay off points on *A C*. These points should be in a straight line, from *A* to *C*, and from *A* to *B*. Holes should then be drilled at these points and tapped to take small long machine screws. Be careful to drill the holes perfectly straight and perpendicular.

Now put the machine screws in the holes. If ½ scale is to be read, place them in No. 2 and No. 5; then the distance between the ends of the dividers is just twice that between the machine screws. To read ¾, use holes Nos. 3 and 6. Nos. 1 and 4 give ¼ size.

The time spent in making this improvement will be more than saved in actual use.—R. L. KENYON.

Soldering Iron for Light Work

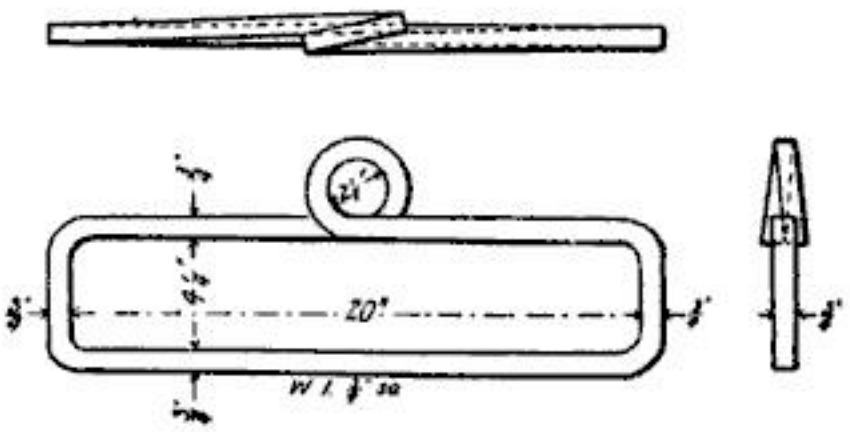
A SOLDERING copper for light work can be made from a length of trolley wire one end of which is filed to a point and the other end bent to fit into a wooden handle.

The Completed Iron, Showing Simplicity and Neatness of Its Construction

Making a Driving-Box Lifter

THE device which is illustrated herewith is designed to be used for lifting driving-boxes with a traveling crane, for use with planers, boring-mills, drill-presses and the like. It is made from two forgings and a ⅜-in. chain. The two rectangular links are made from ¾-in. iron. The ring is made first, then the rectangle, and lastly the two are welded. The link slips over the driving box and the ring is used in the crane hook.

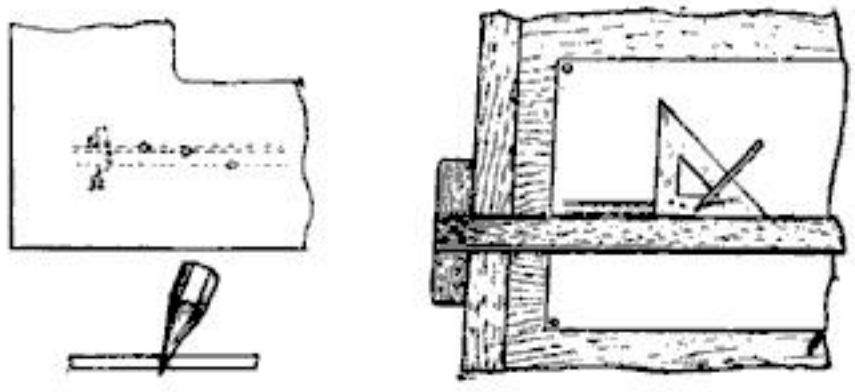
Just as soon as the crane hook is hoisted, the two links are drawn together. An accident is practically impossible. The size of the link can be made to fit any driving-box, though it can be used for any box it will go over, unless the box happens to be very much too small.—JOSEPH K. LONG.



Welded Link Made to Fit Any Driving-Box for Lifting Purposes

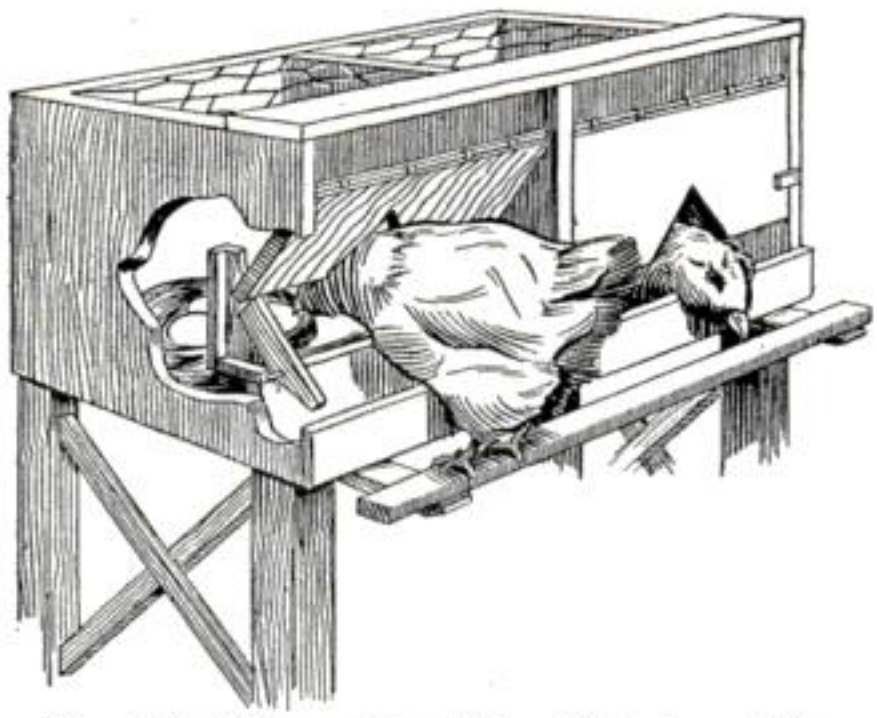
Guide Lines for Lettering

THESE may be ruled by means of a simple left and right gliding movement. Several groups of holes may be drilled in the triangle, thus providing a simple and rapid means of ruling guides for several sizes of lettering. An advantage of this little scheme is the perfect uniformity of the spacing which is obtained.—W. H. SCHEER, JR.



Arrangement of Group of Holes in Triangle and Device in Operation

Getting a Line on Biddy



One Nest Shows the Hen Entering. The Other Shows the Door Automatically Locked

THIS is an illustration of a trap nest—not a guillotine. It is designed to help the poultry breeder to find out his good layers and to keep pedigrees. It is very simple. It may be attached to the underside of the dropping board, with the front facing the pen and arranged so that it can be easily removed. The dropping board will then be the roof of the nest.

The rear of nest may be of wire for the sake of ventilation. If the nest is placed on the wall, slats or wire should be inserted from the front of the nest to the wall at a sharp angle to prevent the hen from roosting on the nest. When she enters the nest, the hen's back raises the door, which releases the catch and allows the door to shut. The catch should be set so that its edge just holds the door, the position being regulated by a screw or nail at the lower inside edge of the catch. A washer on the screw will prevent it from sticking. The guard around the catch holds the nesting material away. The nest should be visited frequently to release the hens.

Boiling Water by Cooling It

NOT a little entertainment can be derived from a burnt-out incandescent light bulb. The spur of glass on the big end is hollow. While you hold that part under the hottest water in which you can keep your hands, carefully file off the point of the bulb. As soon as the water reaches the hollow part, it will enter and immediately begin to boil. This is because the extremely rarefied atmosphere inside lowers the boiling point to the temperature of the water. As soon as the space is filled with steam, the boiling ceases.

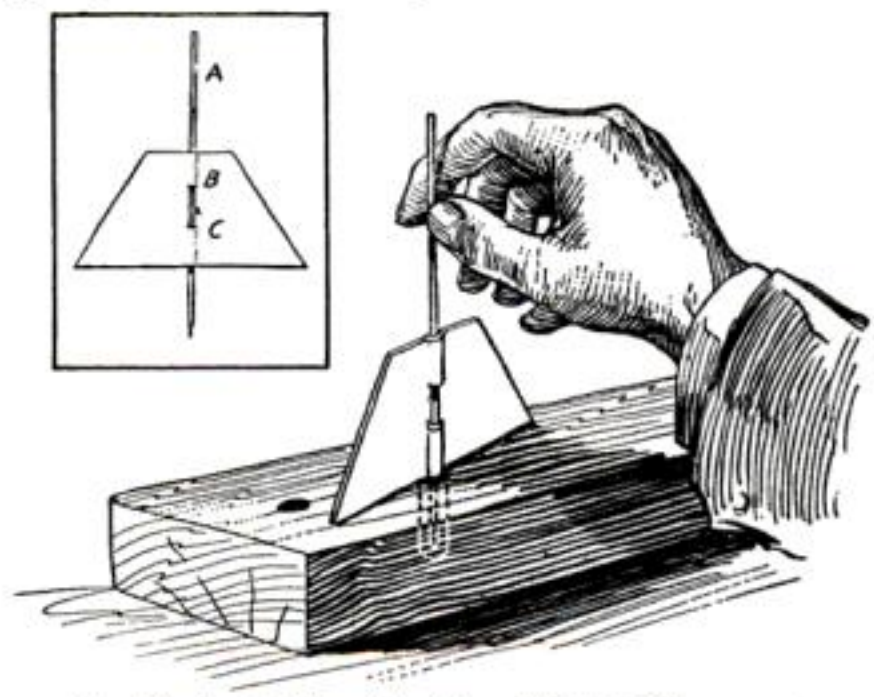
Still keeping the opening under water, or closing it with a moistened finger, hold the bulb under a stream of cold water. The boiling immediately begins again, because the cold water condenses the steam, thereby leaving a partial vacuum.

By closing the opening securely with sealing wax when the bulb is about one-fifth full of water, you will have a very novel and interesting toy. When the water has cooled, inverting the bulb sends the water to the other end with a sharp click. In physics, a similar apparatus is called a water hammer.

The water can be made to boil at will by heating it gradually in a vessel of warm water, and you can always show how water can be made to boil by cooling.—E. P. THORNTON.

To Find Your Depth

THE depth gage illustrated will be found useful for many purposes. It consists of a steel knitting-needle, *A*, passed through two slots, *B C*, in a sheet of copper, the lower edge of which is perfectly straight. If the metal is placed on a piece of soft wood and indented between the slots *B C*, then turned over and similarly treated above and below the slots, a groove will be formed which will accommodate the needle while holding it with sufficient grasp to retain any measurements.



An Indentation in the Metal Forms a Groove in Which the Needle is Grasped

Cheap Photographic Changing Box

Plates Can Be Handled in Broad Daylight

PHOTOGRAPHERS who adopt the tank method of development and so dispense with all the trouble incidental to the older method, can very well do without a dark room except for the purpose of loading and unloading the plate holders. By means of the box illustrated on this page, plates can be handled both before and after exposure with perfect safety in daylight, a dark room being entirely unnecessary.

The box should be oblong, and may be made of thin wood or cardboard. The writer has found a hat box satisfactory for a 4-in. by 5-in. plate outfit, and has in fact used such a box for years. A swing back lid, opening above is the best type. Two circular holes must be cut in one of the sides, large enough to admit the hands easily. A couple of short sleeves, made from black twill (double thickness) must be sewn over these holes securely with stout thread.

The box must be made thoroughly light-tight by covering both inside and out with black cotton lining, to be purchased at a dry-goods store. The corners and the angles formed by the sides should be strengthened with additional strips of the same material, because pinholes are more likely to develop here than elsewhere. A ring of black cloth must also be glued over each of the holes over which the sleeves were sewn, so as to cover any small holes left by the needle.

Particular care must be taken to make the lid fit light-tight. In the case of a hat box the lid is always loose fitting and there is plenty of room in which to sew a piece of black cloth, folded twice, all around the edge of the box. A very simple device may be used for keeping the lid closed while in use. A brass paper fastener should be passed through the side of the box and another through the lid. A few inches of stout thread with a button attached should be tied round the former, the thread being passed twice round the head of the upper fastener to close the lid.

All the plate holders that are to be filled and the unopened packet of plates (or the plate holders after exposure and the developing tank), must be put into the charging box before closing the lid.

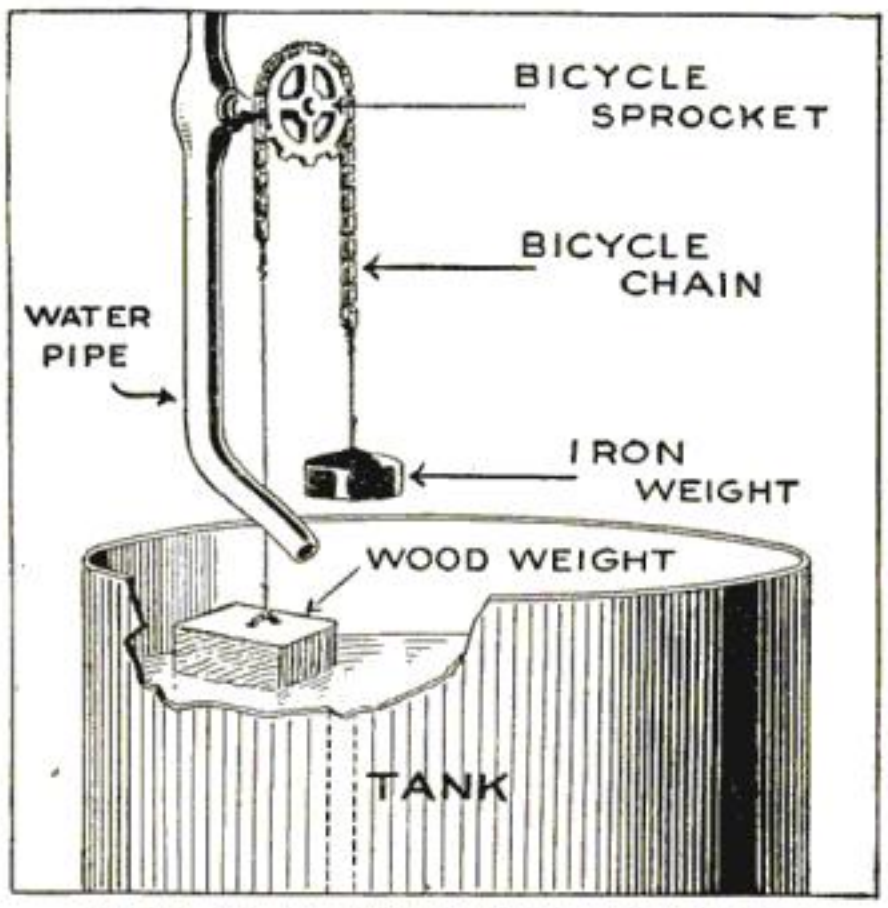
A damp sponge can be kept in a small saucer in the corner of the box for moistening the finger tips, when by touching the extreme corner of each plate, the gelatine will be felt to be sticky.—H. J. GRAY.

An Automatic Faucet for Tanks

AN automatic faucet may be constructed by anyone with the proper pipe-fitting tools.

In the drawing a bicycle sprocket is screwed on to the shank of an ordinary spigot-plug which has been previously threaded to receive it and a lock-nut.

A piece of bicycle-chain is shown on which are suspended two equal weights the former of iron or any heavy material and the latter of wood or something buoyant. To open the faucet the string supporting the wooden weight is pulled down, turning the sprocket to the left and opening the plug. As the water approaches the top of the tank the wooden weight is raised on the surface, allowing the other to descend, closing the spigot automatically.—F. A. WILHELM.



A Pull on the String Supporting Lighter Weight Opens the Plug

The Use of Jigs and Fixtures

By S. H. Samuels

THE average person conceives of "tools" as drills, taps, reamers, etc., but modern automatic machinery has necessitated the use of jigs and fixtures for reproduction work. In shop talk, they also come under the listing of tools.

Jigs and fixtures are mechanical contrivances, such that any mechanical or electrical machine part may be placed and held rigidly, during the process of machining. Opinions vary on the exact distinction to be made between the jig and fixture.

Appliances designed for use on a drill press are called jigs, while those designed for use on other machine tools such as millers, planers, etc., are correctly called fixtures.

Jigs may be employed for drilling, reaming, centering, tapping, etc., all these operations being done on the drill-press type of machine. The fixture is used in milling, turning, broaching, boring, chucking, planing, profiling, cam-cutting, gear-cutting, and many other operations in machine shops.

Jigs and fixtures have two distinct advantages—cheapness and interchangeability of parts. When a small number of machines are to be built, the use of jigs and fixtures would be unpractical and extravagant. When large quantities are to be produced and sent upon the market, however, the results are surprising. The cost is reduced from 50 to 75 per cent, due to less "tooling up" than would be necessary with separate parts.

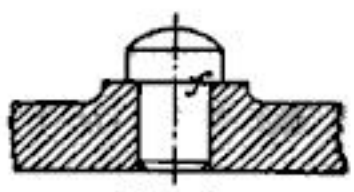


Fig. 1

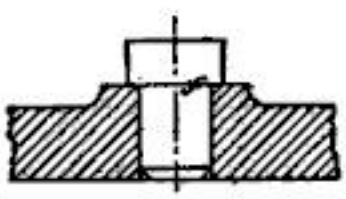


Fig. 2

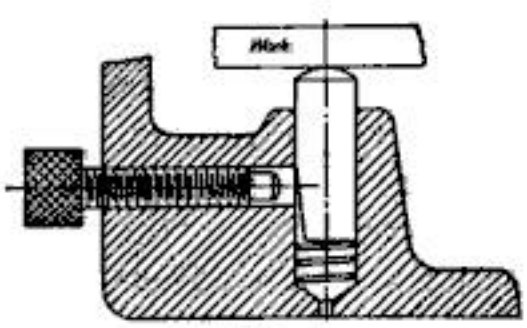


Fig. 3

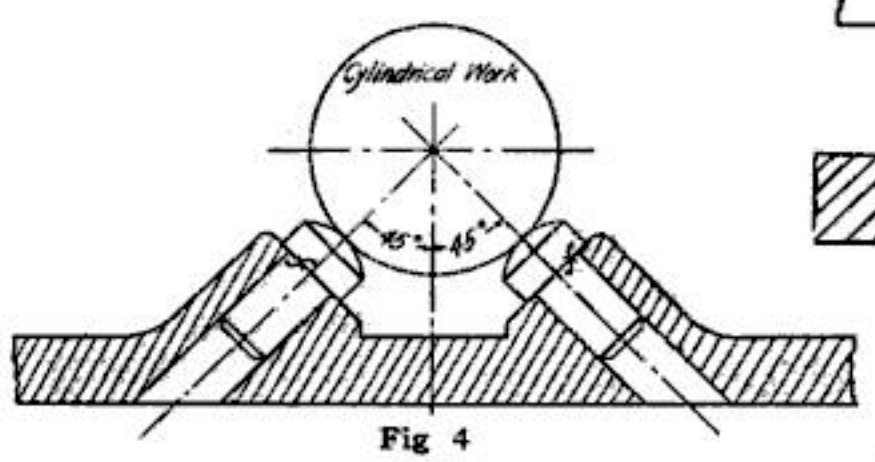


Fig 4

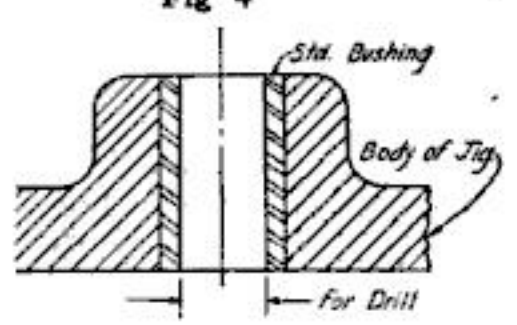


Fig. 7

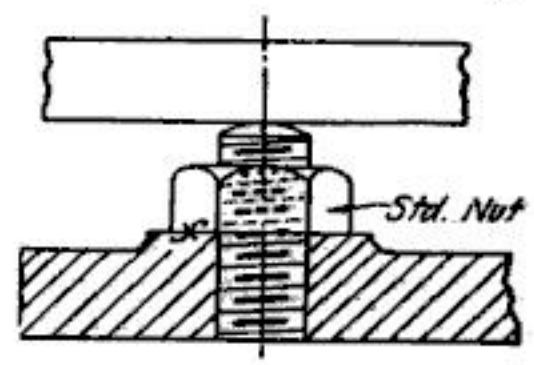


Fig. 5

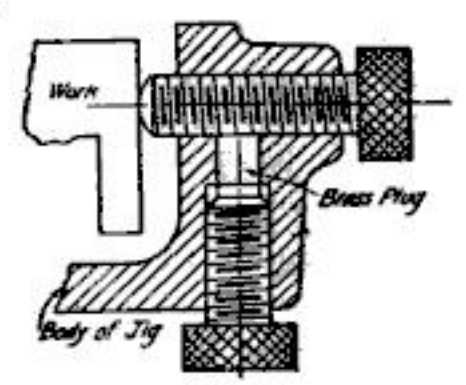


Fig. 6

This reduction in cost is attributed to the fact that unskilled, low-priced workmen may be employed to operate these jigs and fixtures with the same amount of accuracy and rapidity that the well-trained, skilful machinist would do. In fact, the unskilled apprentice, with the use of jigs and fixtures, can accomplish more work, proportionately, than the high-priced machinist, who requires a considerable amount of time to set up the work, measuring accurately every dimension called for by the requirements. Without any doubt, jigs and fixtures eliminate brain work and consequently make machine work purely manual labor.

Since cheap labor is used in operating them, jigs and fixtures must be made "fool-proof," that is, they must have no complicated mechanisms unfamiliar to the workman. To be well designed they must not be "trappy." Interchange-

ability of parts is also essential in modern manufacturing. When a machine is standard, any part may be replaced immediately without either filing or fitting.

This is of great significance, where broken parts of the modern industrial, standard machines have to be renewed. Often these machine parts have to be shipped to remote parts of the world, demanding the necessity of an accurate fitting. Interchangeability is best obtained through the employment of jigs and fixtures, because all parts are held in like manner and distances, thus ensuring mechanical accuracy, which eliminates the unreliability of personal judgment.

Let us consider the location of parts. When a finished surface on a piece of work is used as a means of location, it is best to use steel plates or stool-pins (Fig. 1) for support in the jig. If the locating surfaces are large, they may rest against finished bosses on the jig casting, and then the wear will not be appreciable. A rough casting or forging should rest on three pins as shown in Fig. 2.

If the part is thin or weak, and the tendency is to spring under the thrust of the drill, a spring-pin with a locking-screw may be added for additional support, as shown in Fig. 3. For the location of cylindrical surfaces such as hubs, locating pins set at 45 degrees may be used as shown in Fig. 4. The stops shown in Fig. 4 must be fitted tightly to the jig proper. Sometimes, an adjustable stop may be used as in Fig. 5, thus giving allowance for variation in the casting. These, however, are generally to be avoided as unskilled operators are liable to tamper with them, resulting in an inefficient jig.

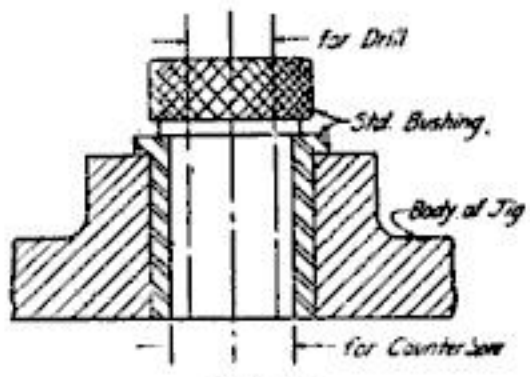


Fig. 8

In locating rough castings or drop forgings, care must be taken to avoid resting them on the pins which occur where the molds or dies are parted. Lack of space sometimes prevents the designer from using the spring-pin support, shown in Fig. 3. In place of it, a small jack-screw may be used, as shown in Fig. 6. A locking-screw with a brass plug must be put in, in order to prevent the jack from working loose because of jarring the jig.

Bushings are used to guide drills, reamers, counter-bores, etc. They are generally of three types, as shown in Figs. 7 and 8. Bushings must be accurately located in the jig to insure exact duplication of each part. The bushing in Fig. 7 fits tightly while in Fig. 8 are shown both tight and loose bushings.

Clamping is done by means of a standard bolt and nuts, according to the conditions. In Fig. 9 is shown the application of a clamping device. In most cases the location points, themselves, will serve in firmly securing the work, without additional aid.

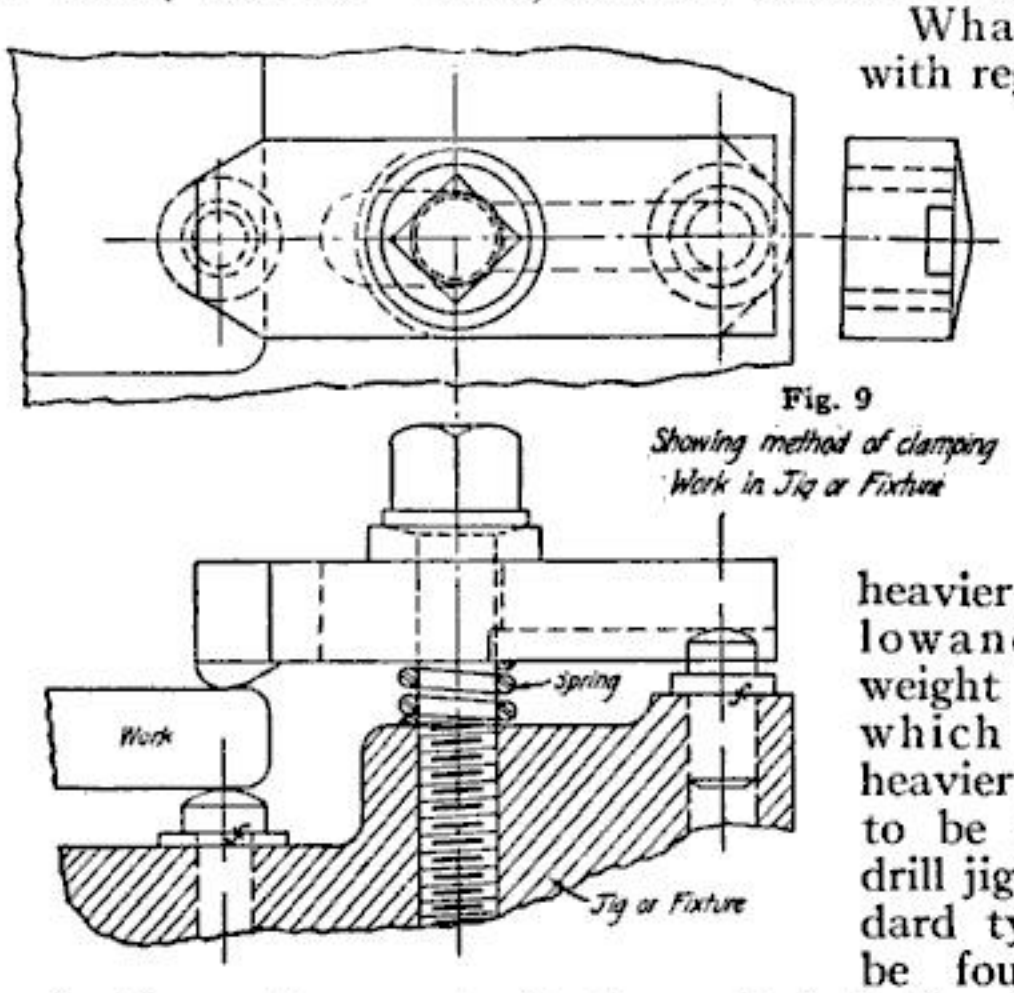


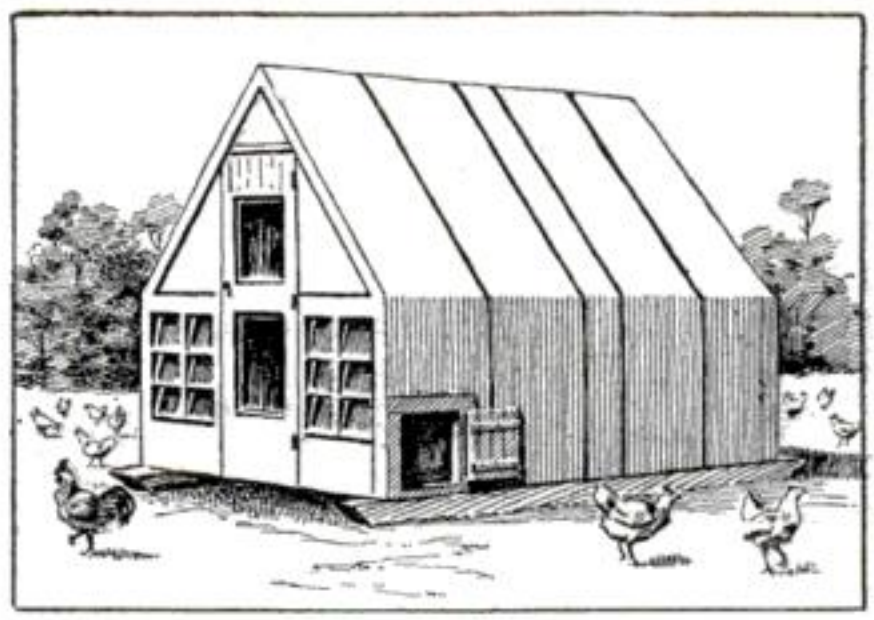
Fig. 9
Showing method of clamping Work in Jig or Fixture

What was said with regard to location and clamping of jigs holds true with fixtures, though the fixture must be built much heavier, to make allowance for the weight of the cut which is usually heavier. Bushings to be used in the drill jigs are of standard type and can be found in any standard machinist's handbook. The few principles of design touched on here by no means exhaust the subject.

A Portable Colony Poultry House

By W. E. Frudden

THIS is a simply built poultry house that will accommodate 30 full-grown birds and the lumber and the roofing matetial that covers the whole house all told, will not cost over $30. It is 8 by 10 ft. in size. Runners or skids furnish a foundation for the house.



The House will Accommodate Flock of 200 to 300 Chicks or 25 to 30 Full-Grown Fowl

The skids are 4 by 4-in. pieces and are 11 ft. long. The drawings show where all the pieces go in the house and the photograph shows how the coop looks when it is ready for use. The list of materials tells the exact sizes of the lumber and the amounts of each to buy. The joists are two-by-fours laid across the skids; when set 2 ft. apart, the same spacing is used for all the framework. All the framing lumber is 2 by 4-in. stock. The floor is covered with 6-in flooring boards, tightly nailed to the joists. The short wall studdings are two-by-fours spaced 2 ft. apart, but at the corners they should be double thick. The wall studdings are 2½ ft. high with a 2 by 4 capped along the top, to which the roof rafters are spiked.

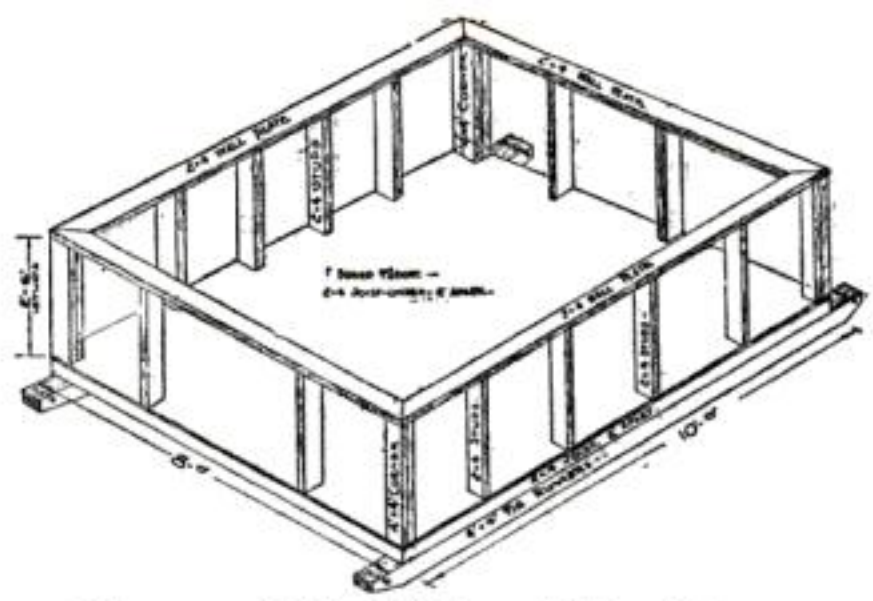


Diagram of the Wall and Floor Framework with Skids for Foundation

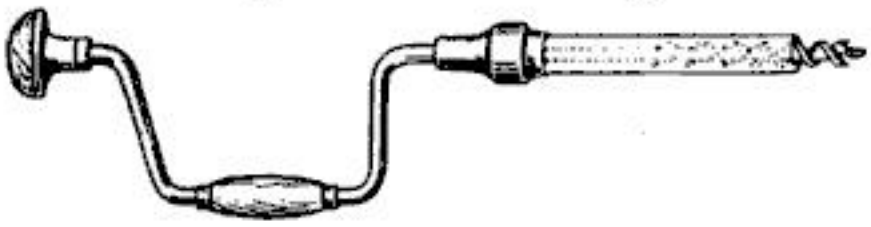
The side walls and the floor framing work is all done first. When this part is completed start with the roof work. The rafters are cut properly to fit. The roof is at half pitch, using 6-ft. lumber for the rafters. With the framing all done, cover the entire coop with 6-in. flooring lumber, well nailed to the rafters and studding with tight joints. Then the whole coop is covered on the outside with a heavy 3-ply roofing paper with cemented joints, put on in the manner described by the manufacturer of the roofing.

The door is screened and muslin-covered for ventilation without drafts, and the glass at both sides of the doorway is built in specially with lapped joints so as to deflect the incoming air upwards towards the ceiling and away from the fowls. Direct aircurrents are dangererous in the coop but fresh air is one of the first and most important essentials in coop building in a modern way. Nests are built in along both sides and the roosts and the dropping boards are located at the rear of the coop. The following material will be needed for this coop:

2 pcs. 4 ins. by 4 ins., 11 ft. long for skids or runners
2 pcs. 2 ins. by 4 ins., 8 ft. long for floor joists
17 pcs. 1 in. by 6 ins., 10 ft. flooring boards
20 pcs. 2 ins. by 4 ins., 2½ ft. long for wall studding
2 pcs. 2 ins. by 4 ins., 10 ft. long for wall plates (sides)
2 pcs. 2 ins. by 4 ins., 8 ft. long for wall plates (ends)
12 pcs. 2 ins. by 4 ins., 6 ft. long for roof rafters
18 pcs. 1 in. by 6 ins., 10 ft. long for ends and door
35 pcs. 1 in. by 6 ins., 10 ft. long for sides and roof
3 rolls (100 sq. ft. each) ready-to-lay roofing material
12 lights glass, 10 ins. by 14 ins., for front
1 cellar sash, 3 lts. 8 ins. by 10 ins., for rear wall
1 screen door, 3 hinges and 1 door lock
15 pounds nails
20 sq. ft. wire mesh screen

How to Drill Holes Quickly in Wood

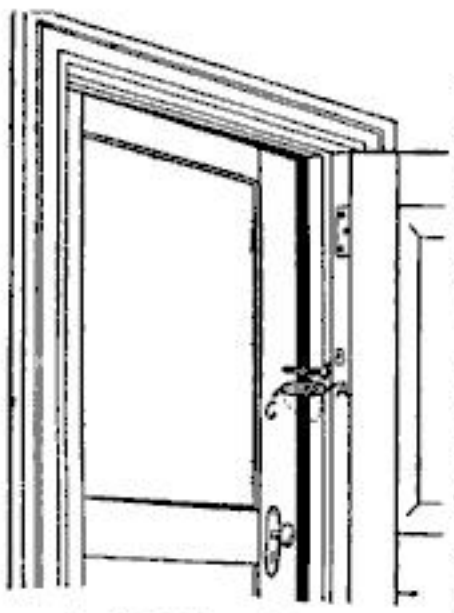
WHEN drilling holes in wood to a predetermined depth, a metal fiber or other tube of the correct length, placed over the bit as shown in drawing, will make it possible to do this part of the



A Tube of Metal Fiber Placed Over the Bit Accelerates the Job

work with a great deal more speed and accuracy than is usually attained by amateurs at the work.—WALTER FRANSEEN.

A Screen Door-Check



A Rubber Button and Small Bolt Are Required

ALTHOUGH a screen door is a summer necessity, it is also a frequent source of annoyance because of its tendency to slam. A pneumatic door-check overcomes the slamming but allows the door to remain open long enough to admit flies. The door-check described, consisting of a rubber button and a small bolt, obviates both difficulties.

The bolt should have a head about ¾ in. in diameter, and a shank about 3 ins. long and ¼ in. in diameter. It is screwed or driven into the inner face of the door near enough to the outside edge to clear the jamb when the door is closed.

The button is a boat-shaped piece of rubber a trifle longer than the bolt. It is attached to the jamb by a screw ¼ of the way from the top of the button. It swings loosely on this screw and hangs by its own weight, as in the illustration, where the door is pictured ajar showing clearly the mechanism.

When the door closes, the projecting head of the bolt, *B*, comes first in contact with *A*, the upper end of the button. As the head of the bolt passes, it swings the button out as indicated by dotted line. The lower end of the button, *C*, thus comes in contact with the face of the door before the door touches the jamb.

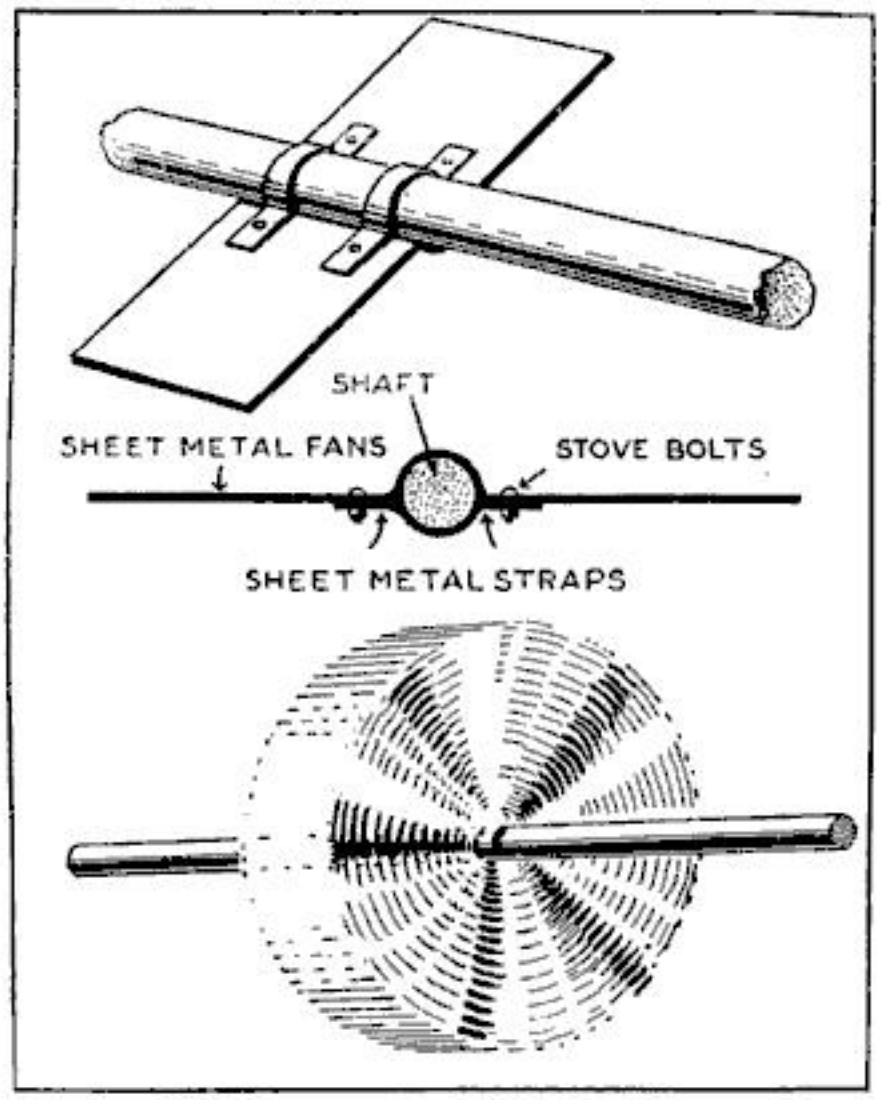
The blow is consequently checked by the rubber and the door closes quickly and without noise. The button drops back into place again ready for the next comer.—E. P. THORNTON.

Cooling a Ship's Laundry

A SHIP'S laundry is a hot place—not the only one, of course, and not the most confining one. Besides there are ways of making this one considerably more comfortable.

Some of the resourceful sailors on board the U. S. S. Maryland who objected to this particular hot place got relief as follows: Several sheets of galvanized iron were cut and bent as shown in the drawing. Two small straps were made to go with each sheet. Holes were punched for small stove bolts, and the fans were attached to the overhead shafting, as shown.

This scheme for improvising fans when shafting is in operation, could be used in many other situations. The bolts should clamp the shaft tightly to prevent slipping.—A. and P. THOMPSON.



Improvised Electric Fan at Rest and in Operation

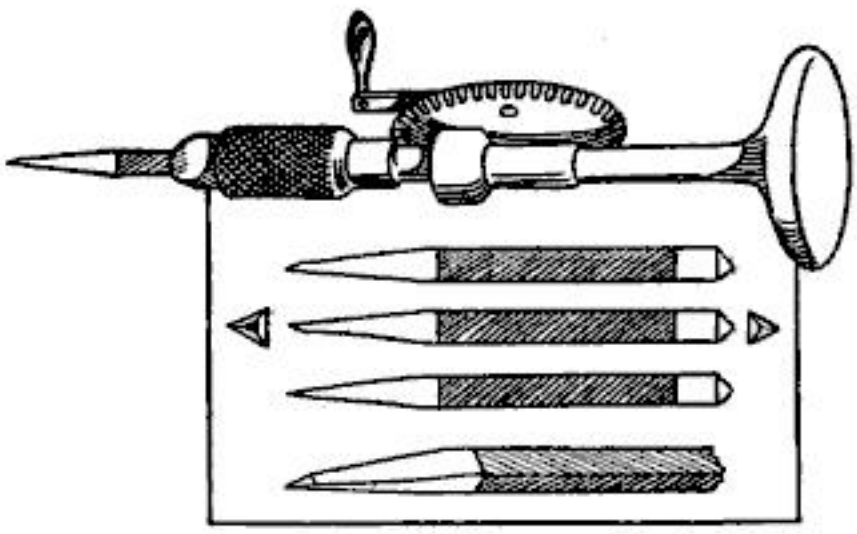


Diagram of a Drill About 3 Inches in Length for Drilling Plate-Glass

Making a Plate-Glass Drill

THE accompanying diagram shows a drill about 3 ins. in length for the drilling of plate-glass. It can be made from an old corner-file. It allows for the drilling of any size hole, which depends on the size of file and the length and size of taper.

The piece of file is ground down along its side on a taper until a point concentric with sides of the file is obtained. The point should then be cut off obliquely, as shown in the illustration. It is then ready for use. Drills of this kind can be used for many years with satisfactory results.—JOHN HAVEKOST.

Coloring of Copper

COPPER and brass lend themselves readily to a coloring process and may be worked to all shades and hues imaginable by merely oxidizing the surface of the metal. Make a paste of iron oxide and graphite with wood alcohol or with plain water, and apply this to the article, which is then heated in an oven or over a suitable gas flame. It is better to use alcohol as it dries out much quicker. The color obtained will depend on the amount of iron oxide mixed with the graphite and the length of time that the heat was maintained. The more oxide in the coating the darker the shade will be. The remains of the coating should be removed with a brush or cloth moistened in alcohol, and when the surface has become quite clean the color should be protected by applying varnish, lacquer or pure wax, which may be laid on with a brush while the copper is heated.

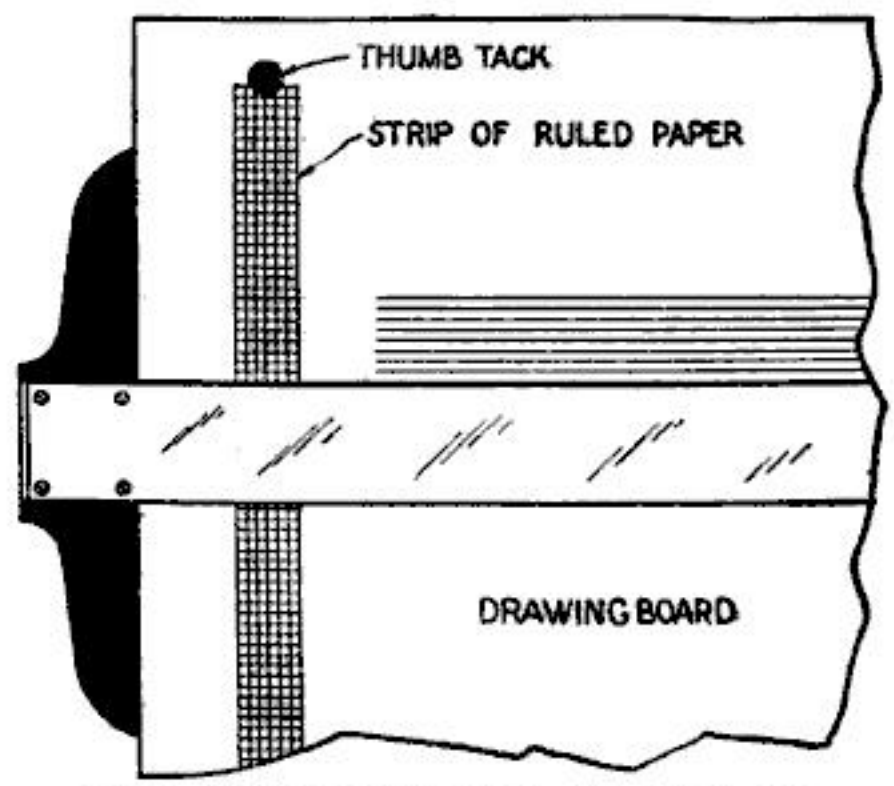
Some brown colors are obtained by using a mixture of verdigris, sal ammoniac and vinegar, using two or three times as much verdigris and sal ammoniac as vinegar. The color or shade can be rendered much darker by adding some blue vitriol to the solution. A red brown may be given by using a vinegar paste, containing equal parts of verdigris and cinnabar, together with two and one-half times as much each of sal ammoniac and alum. The heat treatment is the same as for the other coatings. A wide range of colors comprising shades from blue-black to blue-gray may be given to the copper by dipping it in a hot "liver of sulphur" solution, then washing thoroughly, redipping, or scratch-brushing, and again dipping and washing if desired.

A Handy Spacing Scheme

THE drawing illustrates a handy scheme for drawing parallel lines spaced accurately at equal distances.

Take a strip of ruled paper and fasten it wherever you choose on the drawing-board. The ruled lines on the strip are used for guides either for the T-square or for triangles. The strip may be fastened vertically on the board, horizontally, or at any angle.

In case of absence of ruled quadrangle paper, advertisement borders do very well. I have used the "spaced variety" of advertisement border successfully many times. It will be found in various spacings.—N. G. NEAR.



Ruled Lines on the Strip Are Used for Guides for T-square or Triangles

A Cozy Southern Farmhouse

With the House Facing South, the Living-room and Bedrooms Will Have the Advantage of the Prevailing Summer Breezes

AFTER extensive surveys in the South to determine the household needs of families with reference to local agriculture, climate, and domestic help, the Office of Public Roads and Rural Engineering of the Department of Agriculture has developed a plan for a southern farmhouse which meets all the requirements of a small family. The materials selected are those commonly used in the South, and local dealers should have no difficulty in carrying out the plans.

The aim primarily is to provide a cool and convenient kitchen and dining-room for the housewife; bedrooms and living room with the best exposure; facilities for outdoor sleeping, and an easily-heated house, cool in summer and yet with sunny rooms in winter.

With the house facing south, the living room and bedrooms will have the advantage of the prevailing summer winds, which, generally throughout the South, are from the south or southwest. Where the prevailing winds vary from the usual direction the plan can be reversed if desired, or the house so placed that it will have the proper relation to the summer breezes.

The arrangement of dining-room and kitchen constitutes the chief feature of the plan. The china closet, opening into both rooms, saves a great many steps between the kitchen and the dining-room. The clearing up after meals can be accomplished with a very few steps, dishes being passed through on the wide counter shelf, washed at the sink, drained, and returned to the china closet, where they are available from either side.

The kitchen is small, well-lighted, conveniently arranged, and cool, by reason of the facts that the range is in a separate room and the windows on opposite sides permit a cross draft. The distance from the range to the other fixtures is no greater than in most farm kitchens; and, if it were, the extra step or two would not offset the marked advantage of coolness of the workroom where the greater part of the kitchen work is done. This is a matter of considerable moment, since so many farm wives in the South are now doing their own housework.

The cook-room ceiling has a large opening which permits the heat and cooking odors to escape through a ventilator in the gable. Near the stove, to give light and air, is a double casement window. A grated opening near the floor, in the wall between the cook-room and the kitchen closet, draws air from below the floor and promotes circulation

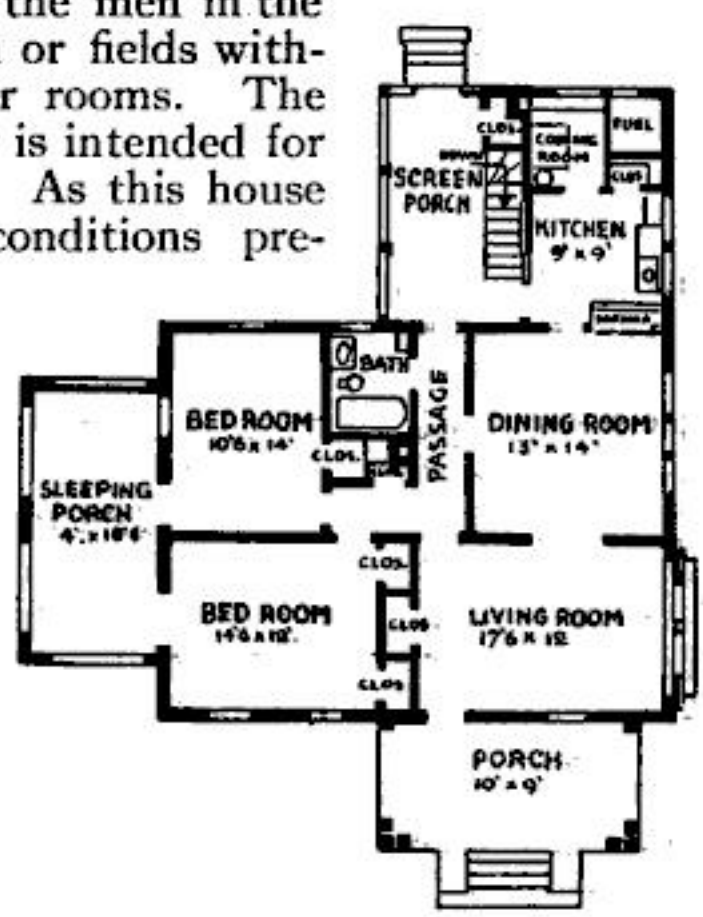
from the floor upward and helps to keep the lower part of the room cool.

In winter, if it is desired to keep the heat in the house, the door between the cook-room and the kitchen can be kept open and the ventilator and grating closed when not needed to carry off odors. The separate and well-ventilated cook-room will insure a dining-room which is cool and free from odors. The fuel-room, filled from outside, is right at hand, obviating the necessity of carrying in fuel every day.

The bathroom is readily accessible from all parts of the house, and can be used for washing up by the men in the family coming from barn or fields without going through other rooms. The closet on the rear gallery is intended for boots, rubber coats, etc. As this house was designed to meet conditions prevailing in the South, no provision was made for a washing room for the farmhands, who, as a rule, have their own quarters.

Instead of open fireplaces for heating purposes, the drawings for this house provide for a hot-air furnace installed in a pit beneath the bathroom. The cost of installation would not greatly exceed that of the two chimneys, with two open fire places each, which would be necessary to heat all the rooms. The upkeep would be less and the efficiency and comfort far in excess of that afforded by open fireplaces. If the situation is low, with water near the surface, the house can be raised higher from the ground and the pit carried down but 3 ft. or so. It should be built of concrete and made waterproof. Space for fuel storage is provided under the rear gallery, and there is a vegetable cellar under the kitchen.

There is less front gallery to this house than in most southern farmhouses. The reason for this is that, while galleries add to the coolness of a house in summer, they keep the winter sun out, making the house damp, cold, and cheerless. Extensive galleries add to the housekeeper's work. If a house has wide eaves and good roof ventilation and is placed so that it is partly shaded by trees, the same beneficial effect afforded by galleries is had in the summertime, while in winter the sun will penetrate each room at some time of the day. The summer temperature within a house is largely influenced by the presence of near-by trees, which, even if they do not shade the building, prevent or lessen radiation from the ground. The plan, however, does provide a comfortable front gallery, and the sleeping porch can also be used as an outside sitting room. Two sleeping compartments can be provided on this porch by using a movable partition or screen.



Storage for Fuel Is Provided Under the Rear Gallery and a Vegetable Cellar Is Under the Kitchen

The sleeping porch should be screened in for summer use and glassed in during the winter, at least on the side most exposed to cold winds and stormy weather. Canvas curtains on rollers to enclose the sides during a storm will answer the same purpose. The floor should be laid with narrow spruce boards, using white lead and oil to fill in the cracks.

To Improve Machinist's Cement

THE red lead used in machinist's cement may be diluted with an equal bulk of silica or other inert substance to make it less powdery on drying. The best way to avoid brittleness and dryness, however, is to add rubber to the oil according to the following recipe:

Linseed oil . . . . . 6 parts by weight
Rubber or gutta-percha . . . . . 1 part by weight

Dissolve the rubber or gutta-percha in sufficient carbon disulphide to give it the consistency of molasses; mix with oil, and leave exposed to the air for about 24 hours. Then mix the oil thus prepared with the red lead to form a putty.

Money Prizes for Motorcyclists

Send Us Your Kinks

IF you are a motorcyclist, if you have devised simple ways of making repairs, if you have improved your machine in any way, this will interest you.

The POPULAR SCIENCE MONTHLY offers a first prize of $25, a second prize of $15 and a third prize of $10 for articles in which motorcyclists will describe and illustrate the methods which they have successfully employed for overcoming trouble, for making quick repairs by the roadside or more difficult repairs in the shop, or for making attachments whereby the use of the motorcycle has been broadened.

Even Though You Don't Win a Prize It's Worth While

The three prizes will be awarded by the editors of the POPULAR SCIENCE MONTHLY in the order of merit. What is more, even though your article may not win a prize, the editors may buy it at the usual rates, because it is so good.

A grease-gun made by twisting a piece of paper into a cone. Hard grease is placed in the cone and simply squeezed out through the small end whenever it is wanted

There are no limitations to this prize offer. We don't care for fine phrasing, but we do care for good mechanical ideas. Rough pencil drawings or photographs will do for illustrations.

Here's What We Want

To give you an idea of the kind of material that will be welcomed, consider the two ideas illustrated on this page. The sidecar illustrated was made from one wheel of an old bicycle, some boards and bar-iron. The grease-gun is merely a cone of paper which is filled with hard grease out of which the lubricant can be squeezed as it is wanted.

This sidecar was made out of one wheel of an old bicycle, a few boards and some bar-iron

Follow These Rules

The following conditions are to be observed:

(1) Articles must be written on one side of the sheet only.

(2) Write your name and address in the upper right-hand corner of the first sheet.

(3) Enclose postage for the return of the manuscript.

(4) Don't send in articles on ideas which have already been published.

(5) Don't send paper ideas—things that you haven't actually done yourself.

(6) Address the envelopes containing articles to

"Motorcycle Contest Editor"

POPULAR SCIENCE MONTHLY

239 Fourth Ave., New York City

The contest will close on December 31st, 1916.

The money for the prizes will be paid promptly after the awards have been made.

An outfit for photographing animals from the bow of the boat. A wooden revolving camera bed, large enough to carry two cameras, is secured to a ball-bearing support which is rigid, absolutely noiseless and enables the camera to be swung through an angle of one hundred and eighty degrees. When the lantern shines on the animal the flash-powder may be fired, provided the distance is correct. If desired, one lamp may be fired after the other successively, to show the animal in different positions. This requires two firing lines and two cameras